THE ROLE OF TEACHERS IN CLASSROOM PEER NETWORKS

BY

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DISSERTATION

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Abstract

This study examined whether and how the quality of teacher-student interactions played a role in the classroom peer ecology as reflected in friendship and victimization dynamics across the school year. Longitudinal social network analysis (SIENA) was conducted on a sample of 2,389 elementary children in 107 classrooms to investigate the development of friendship networks and victimization over time. Meta-analytic random effects and mixed effects models were applied via ‘metaphor’ package to test the moderating role of early teacher-student interactions quality, which was observed using Classroom Assessment Scoring System (CLASS), on the yearlong classroom social dynamics. Results showed that the quality of teacher-student interactions did not significantly moderate the network-level processes related to peer victimization, but significantly moderated the structure of the friendship networks in the classroom. Specifically, in classrooms where teachers had warm and responsive interactions with students, children were more likely to nominate their classmates as friends, creating a tight-knit and egalitarian network structure by the end of the school year. Overall, this study provides evidence consistent with the longstanding view that teachers play a key role in regulating the social dynamics in the classroom.
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CHAPTER 1.

Introduction

The peer ecology is children’s immediate, proximal setting in which peer interactions and socialization occur (Rodkin & Hodges, 2003). Accordingly, the experiences that children have in this setting are of paramount importance to their development (Bronfenbrenner, 1994) – from putting them at risk of developing adjustment problems to providing them with opportunities to hone their social competence, personality, and social development (Dishion, Veronneau, & Myers, 2010; Ladd & Troop-Gordon, 2003; Rudolph & Asher, 2000). Although teachers are not part of the peer ecology, a growing body of work suggests that they play a crucial role in shaping children’s peer interactions (e.g., Farmer, Lines, & Hamm, 2011; Gest & Rodkin, 2011; Shim, Ryan, & Gest, 2015). Yet, empirical work examining how teachers contribute to the social dynamics in the classroom remains scarce. To address this gap in the literature, the present study adopts group-processes theory (Lewin, 1943; Sherif, 1956) and a classroom peer ecology framework (Gest & Rodkin, 2011; Rodkin & Gest, 2011) to examine how teacher-student interactions may set the stage for positive classroom peer ecology, as reflected in the friendships and victimization dynamics of 2,389 elementary school children in 107 classrooms over the school year.

The Classroom Peer Ecology

The classroom peer ecology framework builds upon Lewin’s (1943) and Bronfenbrenner’s (1977; 1994) work on lifespace and multilayered social ecologies (Gest & Rodkin, 2011; Rodkin & Gest, 2011; Rodkin & Hodges, 2003). The peer social ecology is defined as a proximal setting, a *microsystem*, which Bronfenbrenner (1996, p. xv) describes as “the ultimate mechanism through which development occurs.” According to this framework, a
healthy peer ecology is reflected, in part, in the structures of interpersonal connections among children and in the group norms that develop within the ecology. In a healthy peer ecology, children are connected with one another, creating a tight-knit peer structure that is democratic and egalitarian, where social capital – such as friendships – is relatively equally distributed among children. Another feature of a healthy peer ecology is a group norm that values cooperation and inclusion rather than hostility and exclusion (Rodkin & Gest, 2011).

Since an adverse peer ecology can hinder developmental growth, creating a positive social setting is crucial to ensure positive youth outcomes (Rodkin & Gest, 2011). Although teachers are not part of the peer ecology, they play a unique leadership role in the classroom microsystem. One of the central premises of the classroom peer ecology framework is that teachers can affect the classroom social dynamics both directly, through active management of classroom social networks (e.g., Serdiouk, Rodkin, Madill, Logis, & Gest, 2015), and indirectly, through general teacher-student interactions (Gest & Rodkin, 2011). The present study focuses on the latter mechanism, specifically on the role of early teacher-student interactions on the yearlong classroom social dynamics, which are reflected, in part, on the development of friendship networks and individual’s victimization status over the school year.

Victimized Children in the Peer Ecology

Peer victimization is a salient stressor in elementary school (Card & Hodges, 2008; Hanish & Guerra, 2002; Hawker & Boulton, 2000). Exposure to peer victimization has been shown to be associated with internalizing and externalizing problems (Mouttapa, Valente, Gallaher, Rohrbach, & Unger, 2004; Ostrov, 2010; Troop-Gordon & Ladd, 2005), maladaptive social-cognitive processes (Rudolph, Troop-Gordon, & Flynn, 2009), and heightened risk of suicidal ideation (van Geel, Vedder, & Tanilon, 2014). Fortunately, in accordance with the
friendship protection hypothesis, having a best friend can decrease victimization over time and buffer against the negative adjustment often experienced by victimized children (Hodges, Boivin, Vitaro, & Bukowski, 1999; Hodges, Malone, & Perry, 1997; Pellegrini, Barini, & Brooks, 1999). Unfortunately, forming high quality friendships can be quite challenging for victimized children.

Children who are victimized tend to be on the margins of the peer ecology (Rodkin & Hodges, 2003) – other children often refuse to form relationships with victimized peers as they want to protect their own reputation and to avoid ostracism (Bukowski & Sippola, 2001). Previous study has indeed shown that befriending highly victimized children can increase one’s risk of harassment in the long run (Sentse, Dijkstra, Salmivalli, & Cillessen, 2013). The process by which friendships with highly victimized children can influence one’s victimization status has been referred to as victimization contagion phenomenon (Sentse et al., 2013). This phenomenon helps to explain why victimized children remain marginalized and form relationships with other victims as their friendship choice is often limited (Haselager, Hartup, van Lieshout, & Riksen-Walraven, 1998; Hodges et al., 1997). Sadly, friendships with other victims will rarely help victimized children escape their plight, since it can neither help them to be more socially competent nor shield them from future harassment (Rodkin & Hodges, 2003).

Thus, two dynamics appear to occur simultaneously in the peer ecology concerning peer victimization. The first one is a friendship dynamic, which represents changes in one’s friendship networks due to his/her victimization status – such as the marginalization of victimized children. The second is a victimization dynamic, or change in one’s victimization status due to his/her friendship ties – such as the victimization contagion phenomenon. In addition to providing insights into the network-level mechanisms that contribute to the stability of peer victimization,
the patterns of these friendship and victimization dynamics can serve as indicators of the quality of the classroom peer ecology.

For instance, a strong victimization contagion effect, exclusion of victimized children, and groupings based on victimization status may indicate an unhealthy peer ecology. These dynamics suggest that group boundary and exclusivity are the norms. Presumably, the victimization contagion phenomenon can be seen as a penalty for violating the group norms when children extend social connections to highly victimized peers. The rejection and groupings based on victimization status may also reflect children’s inclination to maintain exclusivity or their fear of expulsion. In this setting, it is likely that friendships are not equally distributed among children, since victims will presumably receive fewer friendship nominations compared to non-victims. All these features point to an unfavorable peer ecology that can hinder the development of positive peer relations. On the other hand, in a healthy peer ecology where inclusion and forming positive relations are the norms, victimization contagion may not be as salient because there might be less repercussion for befriending highly victimized children. Consequently, victimized children may be less marginalized over time and may have the opportunity to form positive peer relations that are essential for their adjustment. Whether these patterns of friendships and victimization dynamics vary across classrooms and whether such variability can be accounted for by the quality of teacher-student interactions have not been tested.

**How Might Teacher-Student Interactions Affect the Classroom Peer Ecology?**

According to research in the field of group processes, the group atmosphere – or the general feeling that people in a group have towards each other – can affect interpersonal relations among group members (Lewin, Lippitt, & White, 1939; Moreno, 1934; Sherif, 1951). Lewin’s
classic experiment provides clear evidence that group leaders can dramatically impact group atmosphere through different leadership styles (Lewin & Lippitt, 1938; Lewin, Lippitt, & White, 1939). In this study, the experimenters put several groups of children under democratic or authoritarian leadership style. Children under autocratic leadership soon exhibited aggression against each other, and eventually directed their aggression towards one person, producing a scapegoat. In contrast, children under democratic leadership showed cooperation, spontaneity, and friendliness towards one another. Critically, when the given leadership style switched within-group, so did children’s behavior – formerly aggressive became prosocial, and formerly prosocial became increasingly aggressive. This pioneering study shows not only how different atmospheres change children’s behavior, but also how these atmospheres can be shaped by the adult. Since teachers are the adults and the leaders in the classrooms, they are in position to shape the classroom atmosphere (Cairns & Cairns, 1994; Farmer, Lines, & Hamm, 2011). Akin to the democratic and autocratic leadership styles described in Lewin’s studies, teachers can create different classroom atmospheres through having warm and supportive or harsh and rigid interactions with students.

Bronfenbrenner’s ecological model of development posits that interactions that occur in one setting can influence interactions in another setting (Bronfenbrenner, 1994). For example, conflict in the workplace may carry over to home environment and affect parent-child interactions. Accordingly, interactions between teachers and their students might carry over and have some influence on interactions between students with their peers. Daily interactions between students and their teachers may provide students with the model for interacting with peers. Additionally, by having warm relationships with students, teachers send the message of inclusion. Together, these processes can help to set the stage for positive peer relations.
A growing literature has supported the idea that warm teacher-student interactions can have positive impacts on students’ interactions with one another. For example, emotionally supportive teacher-student interactions have been associated with teacher reports of children’s social competence (Mashburn et al., 2008) among preschoolers, and both teacher report and observed prosocial behavior among fifth grade children (Luckner & Pianta, 2011). Teachers who promoted warm and emotionally supportive environment had been found to have classrooms with lower levels of bullying (Wei, Williams, Chen, & Chang, 2010) and higher rates of reciprocated friendships (Gest & Rodkin, 2011). Moreover, in classrooms where teachers offered high emotional support, children evincing shy, socially anxious behavior have been found to be less victimized and better accepted by their classmates over time (Avant, Gazelle, & Faldowski, 2011; Gazelle, 2006). Finally, one study that looked at the effect of teacher professional development program that aims at improving warm teacher-student interactions found that teachers’ participation in the program was associated with improvement in the observed students’ peer interactions over the course of an academic year (Mikami, Gregory, Allen, Pianta, & Lun, 2011). Specifically, the researchers found increases in the degree of warmth, positive affect, and collaborations among students, not only among friends but also across the whole classroom. The fact that this is not a peer relations intervention program, yet shows positive impact on children’s peer relations supports the premise that teachers can indirectly regulate the whole classroom social dynamics through their way of interacting with students.

The Present Study

Other than theoretical models, relatively little has been done to uncover the mechanisms underlying the positive link between teacher-student interactions and peer interactions in the classroom. To my knowledge, only one study has directly examined the role of teacher-student
interactions in the classroom network dynamics (i.e., Shim et al., 2015). To address this gap in the literature, the current study investigates whether the quality of teacher-student interactions moderates how friendship and victimization dynamics unfold over the school year. In doing so, I use longitudinal classroom friendship networks data, where the development of friendships and victimization among children in the U.S. elementary school classrooms were followed for one academic year. A longitudinal social network analysis called SIENA (Ripley, Snijders, Boda, Vörös, & Preciado, 2016) is applied to estimate the development of two types of changes: friendship networks and individual’s victimization status. As alluded before, these two changes can be strongly intertwined: one’s victimization status can affect and be affected by one’s friendship networks. SIENA is designed to disentangle these two changes, producing separate results that model changes in friendship networks and changes in one’s victimization status over time.

In modeling changes in friendship networks, SIENA estimates the development of friendships formation among children. Based on the aforementioned theory on how victimized children fare in the peer ecology, I hypothesized that on average, children would be less incline to select victimized peers as friends and that victimized children would tend to befriend other victimized classmates (Hypothesis 1). In addition, three basic tie-formation mechanisms would be considered: (1) outdegree or the tendency to send friendship nominations, (2) reciprocity or the tendency to reciprocate friendships, and (3) transitivity or the tendency to befriend friends of friends. Although these three mechanisms are irrelevant to children’s victimization status, together they provide information on the kind of global friendship network structure that is likely to be generated over time. For example, high occurrence of reciprocity and transitivity usually indicate a network that is highly clustered and potentially hierarchical in nature (McFarland,
Moody, Diehl, Smith, & Thomas, 2014). Thus, aside from serving as important covariates, these three mechanisms can offer additional insights into the global friendship network structure in the classroom. In modeling the development of individual’s victimization status over time, SIENA estimates victimization contagion effect, or one’s tendency to experience an increase in victimization when most of his/her friends are also victimized. Based on prior works (Bukowski & Sippola, 2001; Sentse et al., 2013), I also expected to find victimization contagion phenomenon across classrooms (Hypothesis 2).

The main goal of this study, however, is to examine whether there is significant variability in the dynamics of friendship networks and victimization across classrooms, and whether such variability can be accounted for by the quality of teacher-student interactions established early in the school year. In addressing the moderating effect of classroom-level variables on the classroom social dynamics, prior works typically would divide classrooms into subtypes, and then compared the estimated SIENA effects between any two types of classroom using independent t-test (e.g., Rambaran, Dijkstra, & Stark, 2013). In this study, I take a new approach by applying meta-analytic mixed-effects models via the ‘metafor’ package (Viechtbauer, 2010). Using this method, the estimates from SIENA models are used as outcomes in the meta-analysis and the quality of teacher-student interactions is included as a predictor. Stemming from the idea that teacher-student interactions affect peer interactions through changing the quality of the peer ecology, I hypothesized that teacher-student interactions should partly account for variability in the friendships and victimization dynamics in the classroom. Specifically, friendship and victimization dynamics would vary significantly across classrooms (Hypothesis 3), and that in classrooms with higher quality of teacher-student interactions, the tendency for not selecting victimized children as friends and for victimized children to end up
with other victimized peers would be less apparent (*Hypothesis 4*). The possibility that teacher-student interactions might moderate some of the basic tie-formation mechanisms, indicating a more egalitarian network structure in classrooms with higher quality of teacher-student interactions would also be examined. Finally, I expected that the effect of victimization contagion would be weaker in classrooms with higher quality of teacher-student interactions (*Hypothesis 5*).
CHAPTER 2.

Method

Participants

This study is part of a larger multi-cohort, short-term longitudinal project of teaching practices, classroom peer ecologies, and youth outcomes in first-, third-, and fifth-grade classrooms. Different schools and classrooms were recruited each year, and participating schools and classrooms agreed to remain engaged in the study for one academic year. The current analysis was based on data that were collected during all 4 years of data collection (Years 2 to 5 of the larger project) in urban areas in Illinois and Indiana and rural areas in Pennsylvania. Data were collected in the first weeks of school (September-October: Time 1), approximately two months later (November-December: Time 2), and near the end of the school year (April-May: Time 3). Parental consents and student assents were sought for all students in participating classrooms at the beginning of each year. Of 3,938 total students enrolled in 177 classrooms (58 first-, 56-third, and 63 fifth-grade classrooms) across 30 elementary schools, 82% participated at least once and 68% participated at all three time points. At each three assessments, over 80% of students in the classroom participated in the study. Because the unit of analysis is classrooms, everyone who was present at each time point was included in the analysis. There were about the same number of students in each grade (i.e., 1,288, 1,202, and 1,448, in first-, third-, and fifth-grade, respectively). Of 634 students who never participated in the study, 28 students did not return parent consent form, five students were absent during assessment, and the remainder did not receive parental permission. The ethnic composition across the entire sample was approximately 48.7% European American, 33.7% African American, 9.2% Hispanic, 3.7% Asian, and 4.7% classified as other. About half of the sample was male (52%) and 53% qualified
for free/reduced price lunch (25.5% did not qualify and 21.5% had missing lunch status
information).

**Procedure**

Participants completed a survey that took approximately 45 minutes during a regular
class period. First-grade participants completed a survey through an individual interview with a
research assistant. Third- and fifth-grade participants completed the survey as a group; a research
assistant read aloud instructions and questions while the students followed along and recorded
their answers. To maximize privacy, students placed standing folders around their desks to cover
their responses. Participants were reassured that their answers were confidential and that
participation was voluntary. At least two trained assistants were present to assure privacy and to
assist participants.

**Measures**

Friendship networks and peer victimization were assessed using sociometric measures.
Each corresponding sociometric question was followed by a list of all students in the classrooms.
Participants were asked to circle the names of those who fit the description and were permitted to
nominate as many classmates as they wanted, including themselves, or to skip the question if no
one fit the description.

**Friendship networks.** Friendship network was assessed based on a question, “Some
kids have a number of close friends, but others have just one best friend and still others don’t
have a best friend. What about you? Do you have any friends? Please circle the names of your
friends.” Friendship data from each classroom and each assessment point were converted into a
matrix of \( n \) rows and \( n \) columns, where \( n \) represents the number of students who were ever
enrolled in the classroom. Each row represents a nominator and each column represents a
nominee. The cell value can be 0, 1, or NA, depending on whether friendship nomination between a nominator and a nominee was absent, present, or missing, respectively. The current study consists of 531 friendship networks in total (177 classrooms x 3 assessment points), with the size of these networks ranging from 11 to 35 students. There were a total of 25,524 friendship nominations at Time 1, 25,445 at Time 2, and 26,718 at Time 3. Friendship network is a network level variable which serves as the dependent variable when modeling friendship dynamics, and as the independent variable in modeling victimization dynamics.

**Peer victimization.** Peer victimization was assessed using one sociometric item, “These are the kids who are always getting picked on, being made fun of, called bad names, even hit or pushed.” Proportion scores for this item were computed by counting the total number of nominations that each child received (excluding self-nominations) divided by the number of participants in the classroom. Because peer victimization was the dependent variable in modeling victimization dynamics, these proportion scores need to be transformed into discrete ordinal scales to fulfill SIENA computation requirements. To do so, I chose cut-off scores that identify the upper 15% and the upper 5% of the distribution, which corresponds to the proportion of youth anticipated to be eligible for Tier 2 and Tier 3 interventions (e.g., Frey, Lingo, & Nelson, 2010). Specifically, children whose victimization proportion scores ranged from 0.20 to 0.34 was considered to be moderately victimized (~12% of the sample), and those whose scores exceeded 0.34 was considered as highly victimized (~6% of the sample). I also differentiate those who were not named as victims (i.e., victimization proportion scores equal 0; ~29% of the sample) from those who were named at least once (i.e., scores larger than 0 but below 0.20 cut score; ~54% of the sample). Hence, the continuous victimization variable was transformed into 4-point scales where $0 = 0$, $0.01$ to $0.20 = 1$, $0.201$ to $0.34 = 2$, and $> 0.34 = 3$. Separate analyses
using different transformation strategies produced similar findings (see Sensitivity Analyses). Peer victimization is an individual level variable that serves as the independent variable in modeling friendship dynamics, and as the dependent variable in modeling victimization dynamics.

**Teacher-student interactions.** The observed teacher-student interactions were assessed using the Classroom Assessment Scoring System (CLASS; Pianta, LaParo, & Hamre, 2008). Two observers visited classroom during regular class periods and conducted four 20-minutes cycle of observation. At the end of each cycle, each observer rated teachers across ten CLASS dimensions on a 7-point scale, with 1-2 representing low scores, 3-5 representing moderate scores, and 6-7 representing high scores. Intraclass correlation coefficients for each dimensions ranged from .75 to .91. Traditionally, these dimensions are organized into three broad domains of Emotional Support, Classroom Organization, and Instructional Support (Pianta et al., 2008). However, a recent methodological examination of CLASS data suggests that a bifactor approach fit the data significantly better than the typical three-factor model (Hamre, Hatfield, Jamil, & Pianta, 2014). The main issue with the three-factor model is that Emotional Support, Classroom Organization, and Instructional Support are strongly correlated with one another. The bifactor model helps to address this issue by allowing all ten CLASS dimensions to load on “general” and domain-specific elements that are uncorrelated with one another. Following Hamre et al (2014)’s solution, which has been validated by other studies (e.g., Gest, Madill, Zadzora, Miller, & Rodkin, 2014; Serdiouk et al., 2015), the present study used the general element of teacher-student interactions which comprises of positive climate, teacher sensitivity, quality of feedback, and instructional learning formats. This general teacher-student interactions factor has been referred to as responsive teaching and found to be associated with greater cognitive
development, better self-regulation and relational functioning (Hamre et al., 2014). Given that this study was driven by the idea that teacher-student interactions set the stage for the yearlong classroom social dynamics, only responsive teaching assessed in the first three months of school – that is, the average of Time 1 and Time 2 responsive teaching ($r = .51$) – was used in the analysis. Because the bifactor model produced responsive teaching scores that were centered at the grand mean, the resulting averaged responsive teaching scores ranged from -2.80 to 1.82, with $M = 0$ and $SD = 0.84$.

**Classroom demographics.** Prior works have suggested that features of the classroom, such as class size, proportion of boys, and the average socioeconomic status of children in the classroom, can contribute to the quality of the classroom climate and children’s peer relations (Madill, Gest, & Rodkin, 2013; McFarland et al., 2014; Pianta et al., 2005). Accordingly, in testing the moderating role of teacher-student interactions on friendship and victimization dynamics, those variables would be taken into account. Class size was measured based on the total number of students who were enrolled in the classroom at least once, which corresponds to the size of the friendship networks. This number was highly correlated with the number of students enrolled at Time 1, Time 2, and Time 3 ($r = .90$, .89, and .88, respectively). The percentage of boys was the number of boys divided by class size. Classroom SES was based on the number of children who were qualified for free/reduced price lunch, which was obtained from the school records, divided by class size. Hence, high value in classroom SES represents high concentration of children with free/reduced price lunch. Grade was also included as a control variable as the current sample consists of children from different grade levels.
Analyses

Modeling the co-evolution of friendship and victimization dynamics using SIENA.

Data analysis is divided into three steps. In the first step, I fitted a longitudinal social network analysis called SIENA which is implemented within the R package (RSiena version 1.1-290 and R version 3.2.5; Ripley et al., 2016) to estimate the co-evolution of friendship and victimization dynamics in each classroom (Snijders, Steglich, & Schweinberger, 2007). The estimation procedure in SIENA is based on the assumption that changes from one observation to the next are the results of an accumulation of small changes, or “micro steps,” made by individuals in the network that occur in a continuous time. At the beginning of the simulation process, everyone in the network is assigned a “waiting time”, which is determined by the individual’s characteristics and position in the network (e.g., gender, number of friendship connections, etc). This waiting time regulates the number of opportunities and the timing for each individual to make changes. Individual with the shortest waiting time will have the opportunity to make one of the following decisions: alter his/her friendship network by either initiating or dropping a tie, modify his/her victimization status by going one unit up or down, or do nothing. The choice that one makes is governed by the following objective function:

\[ f_i(\beta, x) = \sum_k \beta_k S_{ki}(x), \]

where \( f_i(\beta, x) \) is the value of the function of individual \( i \) depending on the parameter \( \beta \) and the current state of friendship network \( x \). The functions \( S_{ki}(x) \) is the set of effects specified in SIENA model. For example, when reciprocity (which is the \( S_{ki}(x) \) in the formula) is the only effect included in modeling friendship dynamics, and the parameter estimate \( \beta \) for reciprocity is positive, then it means that there is a higher probability for an individual to either initiate a tie that leads to a reciprocated friendship (e.g., \( i \leftrightarrow j \)) or drop a tie that is not reciprocated.
For all possible alternatives, the value $f_i(\beta, x)$ is computed, and it is assumed that individual will make a decision that maximizes that value. Once the decision is made, a new $\beta$ is produced and a new waiting time is generated. The same process repeats until all of the changes between the initially and the finally observed network and behaviors have been modeled. In the end, SIENA produces the estimated $\beta$ and its standard error for each effect included in the model (for a more detailed explanation on SIENA network-behavior dynamics model, see Snijders, van de Bunt, & Steglich, 2010; Steglich, Snijders, & Pearson, 2010).

As SIENA is a probabilistic model, the resulting parameter estimates are in the form of log odds ratio for choosing between two alternatives: to change versus not to change friendships or victimization status (Snijders et al., 2010). To facilitate interpretation of SIENA results, the odd ratios for each parameter estimates are provided, which can be computed by taking the exponential function of the log odds ratio. Once the odds ratios are computed, each effect can be then interpreted as the odds for children to change their friendship ties or victimization status than not to change (Ripley et al., 2016; Snijders et al., 2010) – where the ‘change’ being associated with specific SIENA effect specified in the model. The following sections described the model specification for friendship and victimization dynamics that I fitted in each classroom, along with a more detailed interpretation for each of the effect included to test the study hypotheses.

**Friendship dynamics.** In examining friendship dynamics, gender would be included as a control variable. Gender is a highly salient feature in friendship formation (Kupersmidt, DeRosier, & Patterson, 1995). Research has consistently found preference for same-gender friendships, especially among elementary school children (Maccoby, 1998). To account for this tendency, *same-gender* effect was included, where a positive estimate would indicate a strong
tendency for children to nominate same gender peers as friends. Three structural effects – outdegree, reciprocity, and a transitivity effect called transitive triplets (i.e., the tendency for \( i \rightarrow h \) when \( i \rightarrow j \) and \( j \rightarrow h \)) – would be included to represent the three tie formation mechanisms. To test the role of victimization status on friendship networks, two effects were included: (1) the tendency for children to nominate victimized peers as friends (victim alter) and (2) the tendency for victimized children to form friendships with other victims (victim similarity).

**Victimization dynamics.** As suggested by Snijders et al (2010), linear and quadratic shape effects for victimization were included to control for the general changes in children’s victimization over the school year. A significant and positive (or negative) linear shape effect indicates whether the majority of children score above (or below) the mean of victimization. A positive quadratic shape effect indicates a self-reinforcing pattern in which children with low levels of victimization experience further decline in victimization, whereas those with high levels of victimization experience further increase in victimization over the school year. A negative quadratic shape effect indicates a self-correcting mechanism in which everyone is going towards the mean (Snijders et al., 2010). To examine the presence of victimization contagion phenomenon, average alter effect was included in the model. This effect estimates one’s tendency to experience more severe victimization when his/her friends were highly victimized.

**Meta-analytic random-effects model to compute the average SIENA effect sizes.** After fitting SIENA models in each classroom, the second step was to apply meta-analytic random-effects model via ‘metafor’ package in R (Viechtbauer, 2010) to combine SIENA results from each classroom. The random-effects model assumes that the \( k \) number of classrooms included in the meta-analysis are a random sample derived from a larger, normally distributed population effect sizes with mean of \( \mu_0 \) and variance \( \tau_0^2 \). The goal of meta-analysis is then to
estimate $\mu_0$ or the average true effect and $\tau_0^2$ or the total amount of heterogeneity among the true effects. I used this approach to estimate the average effect size and the variance of this effect size for each SIENA parameter from $k$ number of classrooms. The $z$-statistics were used to test whether the estimated average true effect for each SIENA parameter was significantly different from zero. I hypothesized that the estimated average true effect for victim alter would be negative and significant, indicating that children were less inclined to nominate victimized classmates as friends, whereas the estimated average true effect for victim similarity would be positive and significant, suggesting the tendency for victimized children to form friendships with other victims (Hypothesis 1). I also expected that the estimated victimization contagion effect (i.e., average alter) would be positive and significant, indicating that when children befriend others who had higher levels of victimization, their own victimization level would tend to increase over time (Hypothesis 2).

The amount of heterogeneity for each effect was estimated using restricted maximum likelihood estimator, which has been shown to strike a good balance between efficiency and unbiasedness (Viechtbauer, 2005). The Cochran $Q$ statistics were used to test whether the estimated amount of heterogeneity for each SIENA parameter was significantly larger than would be expected from sampling variability alone. Here, I expected to find significant $Q$-statistics for victim alter, victim similarity, victimization contagion effects, and potentially the three structural effects (i.e., outdegree, reciprocity, and transitive triplets), suggesting that friendship and victimization dynamics varied significantly across classrooms (Hypothesis 3).

**Meta-analytic mixed-effects model to test classroom-level moderators.** In the third step, I fitted a mixed-effects model to test whether responsive teaching moderated victim alter, victim similarity, and victimization contagion effects, as well as the three structural effects
across classrooms. First, I only included responsive teaching as a moderator. Then, grade, class size, percentage of boys, and class SES were added as control variables to test whether the moderating role of responsive teaching would diminish after accounting for these classroom demographics. I expected that victim alter would be less negative and victim similarity would be less positive as responsive teaching increased (Hypothesis 4). Similarly, victimization contagion effect would diminish as the level of responsive teaching increased (Hypothesis 5). Responsive teaching might also moderate some of the structural effects, indicating a more egalitarian global network structure in classrooms with high responsiveness. For example, children might be more likely to nominate a friend (i.e., less negative outdegree effect), but this nomination might not be limited to simply reciprocating a friendship or to befriend friends of a friend (i.e. the effect of reciprocity and transitive triplets might be weaker in high than in low responsive classrooms).

**Missing data.** In the current dataset, missing data in friendship nominations and victimization scores was due to students were absent, not yet enrolled, or no longer enrolled in the classroom at the time of data collection. However, because simulation in SIENA was carried out as if the data was complete, any missing friendship nominations or victimization scores was imputed using an earlier observed values. If such value did not exist, then missing information on friendship nomination was replaced with 0, indicating the absence of friendship ties, whereas missingness for victimization was imputed using the mode value, which was 0 in the current sample (i.e., the majority of children in the current sample was not named as victims). Note that these imputed values did not contribute to the computation of any statistics in SIENA. Only individuals with valid data at the beginning and at the end of a period were considered in the estimation process (Ripley et al., 2016).
CHAPTER 3.

Results

Descriptive Analyses

Model convergence. One of the common challenges in fitting SIENA model is obtaining well-converged estimates, especially when the size of the network is small, such as the classroom network data used in this study. Of the total 177 classrooms available in the current sample, 107 classrooms with 2,389 students satisfied model convergence requirements (see Ripley et al., 2016). Table 1 presents descriptive statistics of the analytic sample and the 70 classrooms excluded from the analyses due to non-convergence. Independent sample t-test showed that converging and non-converging classrooms were not significantly different in the mean levels of responsive teaching, class size, percentage of boys, and classroom SES. However, there were more older grade classrooms in the analytic sample (17 first-, 34 third-, and 56 fifth-grade classrooms) than in the excluded subsample ($t(175) = 7.70, p < .001$).

Regarding the structures of the friendship networks, on average, there were more friendship nominations ($t(175) = 2.14, p < .05$ and $t(175) = 2.51, p < .05$ at Time 1 and 3), reciprocated friendships ($t(175) = 3.47, p < .001$, $t(175) = 2.00, p < .05$, & $t(175) = 2.00, p < .05$ at Time 1-3), and transitive friendship ties ($t(175) = 2.53, p < .05$ and $t(175) = 2.18, p < .05$ at Time 1 and 3) in the analytic sample than in the excluded subsample. The average number of peers who children nominated as friends (or the average outdegree) was significantly higher in included than in excluded classrooms ($t(175) = 2.99, p < .01$ & $t(175) = 3.54, p < .001$ at Time 1 & 3). The analytic sample also generally has higher Jaccard index, which indicates the amount of stability in friendship ties between time points, compared to the non-converging classrooms ($t(175) = 4.12, 3.01, 3.28, p < .01$ at Time 1-3). However, there was no significant differences in
the class size, the number of respondents, the composition changes (i.e., number of stayers, joiners, and leavers), and the proportion of missing data between included and excluded classrooms.

In terms of victimization, independent t-test indicated that classroom mean level of victimization at Time 1 was lower in the analytic sample than in the excluded subsample ($t(175) = -2.19, p < .05$). The analytic sample also had higher proportion of children with stable victimization between time points ($t(122.65) = 3.26, p < .001$ at period 1 and $t(118.61) = 2.56, p < .05$ at period 2). However, there was no significant differences in the proportion of students whose victimization score increased, decreased, or in the proportion of missingness in victimization between converging and non-converging classrooms.

Collectively, these analyses indicate that compared to the excluded classrooms, classrooms included in the analyses have more friendship ties to model but also less drastic changes in friendship networks and victimization between time points, which is essential for model convergence.

**Correlations among classroom-level variables.** Among the analytic classrooms, responsive teaching was negatively correlated with classroom mean level of victimization at Time 3 ($r = -.23, p < .05$), suggesting that higher level of responsive teaching in the first three months of school was associated with lower victimization at the end of the school year. Responsive teaching was also negatively correlated with classroom SES ($r = -.27, p < .01$) and classroom size ($r = -.42, p < .01$). Meanwhile, classroom mean level of victimization was correlated with the proportion of boys ($r = -.22, p < .05$) and classroom SES ($r = .20, p < .05$). Together, these correlations point to the need to account for classroom demographics when examining the link between responsive teaching and peer dynamics in the classroom.
Distribution of victims in classrooms with different levels of responsive teaching.

Figure 1 illustrates the distribution of victimization scores in classrooms with different levels of responsive teaching. To facilitate interpretation, classrooms were divided into low, moderate, and high in responsive teaching using 33rd percentile cutoff points (i.e., responsive teaching scores -2.80 to -.24 = low, -.21 to .39 = moderate, and .40 to 1.82 = high). Within the analytic sample, there were 35 low, 38 moderate, and 34 high responsive teaching classrooms. Regardless of the types of classroom, the majority of children either were never named as victims or had low victimization. However, Figure 1 shows that the majority of children in classrooms with low and moderate responsive teaching had low level of victimization, whereas the majority of children in classrooms with high responsive teaching were almost equally split between those who were never named as a victim and those who had low victimization. Moreover, up to 10% of children were highly victimized in classrooms with low to moderate responsive teaching, compared to only about 5% in classrooms with high responsive teaching. A Kruskal-Wallis H test showed that there was a statistically significant difference in victimization score between different types of classrooms ($\chi^2(2) = 20.64, p < .001$ at Time 1, $\chi^2(2) = 21.81, p < .001$ at Time 2, $\chi^2(2) = 11.62, p < .01$ at Time 3). A Tukey post-hoc test indicated that there was no significant difference between low and moderate classrooms, but there was significant difference between high and low and between high and moderate classrooms in the mean level of victimization across three time points. That is, at each time point, the mean level of victimization in classrooms with low and moderate responsive teaching tended to be higher than it was in classrooms with high responsive teaching.
SIENA Results from Meta-Analytic Random-Effects Model.

Table 3 presents the average effect size of SIENA estimates from meta-analytic random-effects model based on the 107 classrooms that converged.

**Friendship dynamics.** The negative outdegree effect indicates that, in general, the odds for nominating someone as a friend were 75\% lower than the odds for not nominating someone (Est. = -1.41, odds ratio = EXP(-1.41) = 0.25). This pattern is commonly found in the study of friendship networks, suggesting that children typically are not connected with everyone in their peer group. The positive reciprocity and transitive triplets indicate that, on average, children tended to reciprocate friendship ties and to befriend friends of friends, respectively. Positive same-gender effect suggests strong preference towards same-gender than cross-gender friendships.

The negative victim alter suggests that for every increase in children’s victimization level, their odds for being nominated as friends decreased by 6\% (Est. = -0.07, odds ratio = 0.94, \( p < .001 \)). The positive and significant victim similarity effect indicates that the odds for children to choose peers who shared similar victimization levels were 75\% higher than the odds to choose those with distinct victimization levels (Est. = 0.56, odds ratio = 1.75, \( p < .001 \)). Thus, consistent with Hypothesis 1, victimized children were less likely to be nominated as friends and that victimized children were more likely to form friendships with other victims.

**Victimization dynamics.** The negative linear shape effect suggests that, the majority of children scored below the mean of victimization. The negative quadratic shape effect indicates that in general, children with high level of victimization scores tended to decrease, whereas children with low level of victimization scores tended to increase in victimization over time (“regression to the mean”). The main interest of this part of modeling is the victimization
contagion effect. Consistent with Hypothesis 2, the positive and significant estimate for this effect suggests that friendships with highly victimized peers tended to increase one’s victimization over time (Est. = 1.01, odds ratio = 2.75, \( p < .001 \)). Specifically, the odds for children to experience an increase in victimization ranged from 2.75 (\( \text{EXP}(1.01) \)) when their friends’ average victimization level was low (average score = 1) to 20.7 (\( \text{EXP}(1.01 \times 3) \)) when their friends’ average victimization level was high (average score = 3).

Variability in friendship and victimization dynamics. Hypothesis 3 was partly supported in that the \( Q \) statistics for victim alter, victim similarity, and the three structural effects were significant, suggesting that friendship dynamics varied significantly across classrooms and that this variability was higher than would be expected from sampling variability alone. Nevertheless, the non-significant \( Q \) statistics for victimization contagion effect indicates that variability in the strength of victimization contagion phenomenon across classroom was not higher than would be expected from sampling variability alone.

Meta-Analytic Mixed-Effects Model to Test Classroom-Level Moderators.

Table 4 presents the results of meta-analytic mixed effects models. In Model 1, responsive teaching was the only moderator in the model, whereas in Model 2, classroom demographics were also included as control variables. In both models, the estimated coefficient for each moderator along with its standard error were reported, which can be used for significant testing. The amount of residual heterogeneity (\( \hat{\tau}^2 \)), when compared to the \( \hat{\tau}^2 \) from the random-effects model, can be used to compute the total amount of heterogeneity that can be accounted for by including moderator(s) in the model. The result of this computation is the same as the \( R^2 \) statistics (which can be regarded as a pseudo \( R^2 \) statistics). Overall, results in Table 4 demonstrate that responsive teaching only significantly moderated outdegree and transitive
triplets, even after accounting for classroom demographics. Below is a more detail interpretation of the results from Model 2.

**The moderating role of responsive teaching on friendship dynamics.** Contrary to Hypothesis 4, results from Model 2 suggest that responsive teaching did not significantly moderate victim alter and victim similarity. In other words, there was no strong evidence that differences in the levels of responsive teaching contributed to variability in the tendency for victimized children to be named as friends (victim alter) and in the tendency for victimized children to befriend other victims (victim similarity). However, responsive teaching significantly moderated outdegree and transitive triplets even after accounting for other classroom demographics. Specifically, for every one point increase in responsive teaching, the log odds of outdegree increased by 0.09 (Est. = 0.09, z = 2.00, p < .05, 95% CI = 0.00 to 0.19) and the log odds of transitive triplets decreased by 0.02 (Est. = -0.02, z = -3.59, p < .001, 95% CI = -0.03 to -0.01). Responsive teaching and classroom demographics accounted for 4.36% of variability in outdegree and 11.04% of variability in transitive triplets.

To facilitate interpretation, I computed the predicted average log odds of outdegree and transitive triplets for various levels of responsive teaching, transformed them into odds ratio, and provided the corresponding 95% confidence interval for the odds ratio (OR). These predicted values can be found in Table 5. For outdegree, Table 5(a) shows that for every one point increase in responsive teaching, the odds for children to nominate a friend increased by approximately 2% (OR ranged from 0.20 to 0.29). For transitive triplets, Table 5(b) shows that the odds for children to befriend friends of friends decreased by about 3% for every one point increase in responsive teaching (OR declined from 1.20 to 1.10). Together, the findings on outdegree and transitive triplets suggest that compared with children in less responsive classrooms, those in high
responsive classrooms provided more friendship nominations that were not necessarily directed to friends of friends only.

**The moderating role of responsive teaching on victimization dynamics.** Also contrary to Hypothesis 5, results from Model 2 suggest that responsive teaching did not significantly moderate victimization contagion effects. In other words, the current analysis did not find strong evidence that differences in the levels of responsive teaching accounted for variability in victimization contagion phenomenon across classrooms.

**The moderating role of classroom demographics on friendship and victimization dynamics.** Model 2 shows that in addition to responsive teaching, classroom size also appeared to be a significant moderator for transitive triplets: an additional student in the classroom was associated with 0.004 decreased in the log odds of transitive triplets. Computation of the predicted odds ratio in Table 5(c) shows that holding other classroom demographics and responsive teaching at the sample mean, for every additional student in the classroom, the odds for children to befriend a friend of a friend decreased by 0.4%. The significant effects of grade and classroom SES on victim similarity also suggest that the tendency to form friendship based on similarity in victimization status was more apparent among older children (Est. = 0.21, z = 3.10, p < .01) and in lower SES classrooms (Est. = 1.11, z = 3.09, p < .01). Specifically, Table 5(e) shows that holding responsive teaching and other classroom demographics at the sample mean, the odds for children to choose peers who shared similar victimization levels than to choose those with distinct victimization levels were 15% lower among first-graders (predicted OR = 0.85), 30% higher among third graders (predicted OR = 1.30), and were 98% higher among fifth-graders (predicted OR = 1.98). Similarly, holding responsive teaching and other classroom demographics at the sample mean, Table 5(f) shows that the odds for friendship
formation based on similarity in victimization status ranged from 0.81 in classroom where no students were qualified for free/reduced price lunch to 2.15 in classroom where 88% of the students were qualified for free/reduced price lunch.

**Post-hoc Analyses**

Overall, the results from the meta-analyses indicate that compared with less responsive classrooms, classrooms with high responsive teaching were characterized by more friendship nominations that were equally distributed among children over the school year. To help translate what the network processes produced in SIENA analyses might mean in terms of individual adjustment and the general classroom atmosphere, I looked at the correlations among responsive teaching, friendship density in the classrooms, averaged received friendship nominations, and children self-reported peer community at each time point. Density was based on the total number of existing ties in the classroom divided by all possible ties, hence representing the mean level of connectedness among children in the classroom. Self-reported peer community was based on five 5-likert scale items (1=never, 5= always): “Kids in my classroom help each other,” “My teacher and classmates treat each other with respect,” “People care about each other in my classroom,” “Kids in my classroom work together to solve problems,” and “Kids in my classroom do nice things for each other.”

Correlation matrices show that responsive teaching was positively correlated with friendship density at each time point ($r = .39, .37, .35, p < .01$, at Time 1-3, respectively), suggesting that there were more friendship connections among children in classrooms where teachers had warm and responsive interactions with students. Responsive teaching was also positively associated with proportion of received friendship nominations ($r = .22, .14, .09, p < .01$, at Time 1-3, respectively) and self-reported peer community at each time point ($r = .25, .24,$
.23, \( p < .01 \), at Time 1-3, respectively). These correlations complement the network processes showed by SIENA analyses, indicating that in classrooms with high levels of responsive teaching, children sent and received more friendship nominations, creating a tight-knit peer network structure where children felt a sense of support and respect from their classmates and teacher.

**Sensitivity Analyses**

To assess sensitivity of these results to the specification of models and the subsets of data used in the analyses, I estimated a number of alternative models. First, good estimations are typically obtained when the data has few or no missing data and with Jaccard index of at least .30 (Snijders et al., 2010; Ripley et al., 2016). Despite that, to retain as many classrooms as possible, the current analyses included all 107 converging classrooms regardless of the percentage of participants (which ranged from 57\% to 100\%), the percentage of missing data (ranged from 0\% to 64\%), and the Jaccard coefficient (ranged from .17 to .86). Since the inclusion of less favorable classrooms may potentially influence the results, I fitted two alternative models. One model used a set of classrooms with at least 68\% participants at each time point, which yielded to 88 analytic classrooms, and another model used a set of classrooms with Jaccard index of at least .30 and with less than 30\% missing data, which resulted in 73 analytic classrooms.

Second, the way the continuous victimization scores were transformed into ordinal scales may affect the results. Some transformations may reflect more regular changes in victimization from wave to wave, some may show more abrupt changes, and some may reflect no changes. These differences can in turn affect the estimation process and the results. Moreover, the number of converging classrooms change depending on which transformations were used (see
Supplementary Materials). Therefore, to test the robustness of the current results, I estimated several models using victimization scores transformed using 33rd percentile cut-scores (estimations converged in 98 classrooms), 25th percentile cutoff points (estimations converged in 102 classrooms), 0.20 cut-scores (i.e., 0 = 0, 0.01-0.20 = 1, > 0.20 = 2; estimations converged in 83 classrooms), and binary variable using 0.15 (61 classrooms) as well as 0.20 cut-scores (48 classrooms).

Finally, as the data consists of different grade levels, it is possible that the moderating role of responsive teaching on the classroom social dynamics varies by grade. Thus, I estimated an alternative meta-analytic mixed-effects model that included responsive teaching, grade, and an interaction between grade and responsive teaching. This interaction effect was not significant, hence was excluded from the current study. None of these alternative specifications produced substantially different results from the ones reported in this study.
CHAPTER 4.

Discussion

The idea that teachers can promote children’s peer relations is not new. In his seminal work, *Sociometry in the Classroom*, Norman Gronlund (1951) showed practical ways in which teachers can improve children’s social relations at school. Around the same time, Redl and Wattenberg (1959)’s *Mental Hygiene in Teaching* suggested that, “The forces which are at work in young people’s groups are influenced by the entire setting in which they operate. A significant aspect of that setting is the teacher” (p. 294). Building upon this long-standing assertion, the current study examined whether and how high quality teacher-student interactions may set the stage for a healthy peer ecology. I hypothesized that high levels of responsiveness in teacher-student interactions would be associated with a more positive patterns of friendship and victimization dynamics within an academic year, such that there would be less apparent victimization contagion, less rejection of victimized children, and lack of evidence for friendship formation based on victimization status.

Results from the longitudinal social network analyses provide some support on the study hypotheses. As expected, victimized children were generally less likely to be named as friends and they often ended up with other victims. There was also a tendency for victimization contagion across classrooms, suggesting that friendships with victimized children tend to increase one’s risk of victimization over time. However, contrary to my expectation, responsive teaching did not directly moderate any of these dynamics. Still, the significant moderating effect of responsive teaching on outdegree and transitive triplets, even after controlling for other classroom demographics, suggests that teacher-student interactions may affect the classroom
peer ecology more broadly through promoting an egalitarian peer structure – which is one of the defining features of a healthy peer ecology (Rodkin & Gest, 2011).

**The Moderating Effect of Responsive Teaching on Outdegree and Transitivity**

Outdegree is the tendency for children to send friendship nominations. In general, the outdegree effect in SIENA is expected to be negative, indicating that children tend to nominate fewer classmates than they could. Indeed, that is the general pattern that was found in the current sample. However, the significant moderating effect of responsive teaching on outdegree, even after controlling for other classroom demographics, indicates that children tended to nominate more classmates as friends in classrooms where teachers had warm and responsive interactions with students. Since the outdegree effect is also often used as an index of network density, or the degree of connectedness among individuals within the network, the moderating effect of responsive teaching on outdegree also means that children are more connected with one another in classrooms where teachers interact with students with high levels of responsiveness.

The transitive effect examined in the current analysis refers to the tendency for $i \rightarrow h$ when $i \rightarrow j$ and $j \rightarrow h$, or the pressure to be friends with a friend of my friend. According to McFarland and colleagues (2014), such pressure represents the basic needs for individuals to seek security and solidarity, thus might be amplified in social settings where the feelings of insecurity, the issue of trust and group boundaries are salient. Therefore, the finding that the tendency to form transitive friendships was attenuated in classrooms with high responsive teaching suggests that by having warm and responsive interactions with students, teachers may create a sense of security among their pupils.

From a social network perspective, the global network structure, such as clustering, hierarchies, and segregation, can be predicted by examining structural patterns at the dyad and
triad level, such as reciprocity and transitivity (Holland & Leinhardt, 1976; McFarland et al., 2014). The type of transitivity effect included in the current analysis (i.e., *transitive triplets*) is commonly used to represent local hierarchy in the friendship network, as one member of the triad receives more friendship nominations than the other two. Accordingly, the attenuating effect of transitivity in classrooms with high responsive teaching suggests a global network structure that is less hierarchical, which have been shown to be indicative of healthier, more inclusive classroom environment (Cohen & Lotan, 1995; Garandeau, Ahn, & Rodkin, 2011).

Together, the moderating effect of responsive teaching on the patterns of outdegree and transitivity suggest that in classrooms with high quality teacher-student interactions, children were more connected with one another, and these connections were likely to be equally distributed among children rather than directed towards friends of friends only. Based on previous studies on the link between peer network structure and peer norms, this egalitarian classroom network structure may in turn create a secure and inclusive classroom environment conducive for the development of harmonious peer interactions (Hanish, Martin, Miller, Fabes, DeLay, & Updegraff, 2016). Results from the post-hoc analysis seem to support this notion by showing that responsive teaching was positively associated with more friendship nominations, interconnections among children, and children’s sense of support and community in the classroom. In sum, high quality teacher-student interactions contribute to shaping a healthy peer ecology, as indicated in the more egalitarian friendship network and in the sense of support and security felt among the children.

**Responsive Teaching and Classroom Social Dynamics Related to Victimization**

The absence of the significant moderating role of responsive teaching on the classroom social dynamics related to victimization could be explained by the idea that teacher-student
interactions may consist of “both general and specific features” (Hamre et al., 2014, p. 1258) that in turn have general and specific associations with children’s peer interactions. Since responsive teaching represents a more general teaching practice (Gest & Rodkin, 2011), its effect may be more apparent on the broader classroom context, such as the global structure of the peer ecology, rather than on the specific peer experience such as victimization. A more specific teaching practice, such as teacher’s effort to mitigate social status discrepancy in the classroom, may have a more notable effect on the classroom social dynamics associated with peer victimization (Serdiouk et al., 2015).

It might also be the case that victimized children in classrooms with low responsive teaching have distinct circumstances from those in classrooms with high responsive teaching. They may vary in terms of the duration and the type of victimization that they experienced or any other behavioral characteristics. These individual differences may in turn affect how friendships and victimization dynamics unfold, which was not considered in the current study. Alternatively, it could be that change in children’s attitude towards victimized peers cannot be captured within one academic year. Nevertheless, despite the absence of the moderating role of responsive teaching on the network-level processes associated with peer victimization, descriptive statistics show that the prevalence of victimization tends to be lower and might even decline over time in classrooms with high quality teacher-student interactions.

**Grade and Classroom SES Moderate Friendships based on Victimization Status**

Other than responsive teaching, grade and classroom SES appear to be the two significant moderators for friendship dynamics related to victimization, specifically on victimized children’s tendency to form friendships with other victims (i.e., victim similarity effect). The significant moderating effect of grade on victim similarity might be related to children’s better social
cognition as they transition into the “age of reason” which begins around the age of seven (Konner, 2010). During this transition, children may have an increased awareness of the social pecking order in the classroom. Considering that victimization is often a marker of children’s social status (Buhs, Ladd, & Herald, 2006), the finding that older children grouped themselves based on victimization status is consistent with previous study that has shown the salient role of status as an organizing factor among older elementary school children (Logis, Rodkin, Gest, & Ahn, 2013).

Regarding the moderating role of classroom SES, prior works have shown that high concentration of students with low SES was linked to school violence and diminished school climate (Bradshaw, Sawyer, & O’Brennan, 2009; Koth, Bradshaw, & leaf, 2008). Bradshaw and colleagues (2009) found that higher percentage of students who received free/reduced price lunch was associated with an increase in the odds of bullying and victimization at school. Accordingly, the stronger tendency for victimized children to befriend other victims in classrooms with lower SES level might be because the marginalization of victimized children was more severe in these potentially more hostile classroom environment. This more severe marginalization further limit victimized children’s friendship choice which then force them to befriend other victimized children.

**Future Directions**

Results from the current study offer a few insights for future research on teaching practices and the classroom peer ecology. The current study only used one type of triad census (i.e., transitive triplets) to avoid model convergence issue. Yet, there are 16 different types of triad census. Further examinations that include additional triad closure mechanisms are needed to give a more nuance story and stronger evidence on the link between high quality teacher-student...
interactions and a more egalitarian network structure. Future studies that examine aspect of teaching practices associated with the structure of the peer ecology would be beneficial as a growing body of work has shown the strong association between the peer network structure and the classroom peer norms (Ahn et al., 2010; Garandeau et al., 2011), which govern children’s social behavior and relationships with one another.

Future studies could also examine whether “network-related” teaching (Gest & Rodkin, 2011) would be more efficient in promoting the social relations of victimized children. An experimental study on classroom seating arrangement found that reducing the physical distance of children who did not like each other was associated with decreases in peer victimization in the classroom (van den Berg, Segers, Cillessen, 2012). Understanding how general teacher-student interactions versus specific network management strategies operate in creating a healthy classroom peer ecology can eventually provide teachers with practical tools to promote their classroom climate.

Finally, it is important to note that responsive teaching was assessed using CLASS measure where the observed children’s interactions with peers and their behaviors also contribute to the scoring system. Hence, it is possible that high levels of responsive teaching may be partly due to having a classroom that consists of well-behaving children in the first place. Future studies that include the examination of bidirectional relations between peer-relations and teacher-student interactions will provide better insights into understanding how each factor contributes to shaping the classroom peer ecology. Additionally, form the study design perspective, future studies would benefit from observing teacher-students interactions in the first few days of schools to capture how teachers set up the climate at the very beginning of the school year.
Limitations

The current study had some caveats. First, despite my effort to improve model convergence by trying different transformations for victimization variable, changing the simulation’s starting value, and extending the simulation to obtain better convergence, I was still unable to include all classrooms in the analyses. Although classrooms included and excluded from the analyses do not vary significantly in the mean level of responsive teaching and victimization, the patterns of friendship and victimization dynamics between these two subsamples might be different. After all, the excluded classrooms generally have fewer friendships and more drastic changes in victimization status between two time points compared to the analytic sample.

Second, since the majority of the analytic sample consists of fifth grade classrooms, followed by third and first graders, it is possible that the current results mostly represent friendship and victimization dynamics among older elementary school children. Nevertheless, sensitivity analysis testing the interaction between grade and responsive teaching suggests that there was no statistically significant grade difference in the role of responsive teaching on the classroom social dynamics. Third, because of the small size of the classroom, a complex SIENA model can easily result in non-convergence (Ripley et al., 2016). Hence, there are confounding variables related to victimization – such as aggressive behavior or rejection (Ostrov, 2010) – that were not included in the current analysis to avoid convergence issue. Adding this child’s characteristics as covariates in estimating the friendship and victimization dynamics can provide a more nuance understanding regarding who tended to befriend victimized classmates in the first place, and whether being rejected or having high aggression level put one at a higher risk for being victimized above and beyond who they are affiliated with.
Finally, victimization was measured based on a single peer nomination item that includes both verbal and physical victimization. However, previous study has shown that friendship and victimization dynamics vary depending on the types of victimization. For example, in one study that examined friendship and victimization dynamics among middle school children, Sentse and colleagues (2013) showed that the tendency to befriend other similarly victimized peers was found among physically victimized, but not among relationally victimized youths. Victimization contagion was also observed for relational victimization but not for physical victimization. If these different dynamics occur among elementary students as well, then the current finding needs to be interpreted with caution as it may represent cumulative dynamics of relationally and physically victimized children.

Implications

Aside from these limitations, the current study is one of the few empirical works that attempt to uncover potential mechanisms underlying the positive link between teacher-student interactions and student-peer interactions. One of the implications of this study is that teachers’ daily interactions with students do play a role in shaping a healthy peer ecology. The network mechanisms found in this study point to a more egalitarian, secure, and friendly classroom environment when teachers interact with students with high levels of warmth, support, and responsiveness. The focus on the whole classroom network dynamics also brings back the views that classrooms consist of groups of children rather than isolated individuals (Redl & Wattenberg, 1959). The application of longitudinal social network analysis enables the present study to take a step further beyond examining individual-level processes to network-level mechanisms that operate throughout the school year. Overall, this study provides evidence
supporting the notion that although teachers are not part of children’s peer group, they have the power to set the stage for a healthy peer ecology through their daily interactions with students.
CHAPTER 5.

Tables and Figures

Table 1
Descriptive Statistics for the Classroom Characteristics, Friendship Networks, and Victimization Dynamics

<table>
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<tr>
<th></th>
<th>Analytic Sample</th>
<th>Did Not Converge</th>
<th>Total Sample</th>
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<tr>
<td></td>
<td>107 classrooms (N = 2,389)</td>
<td>70 classrooms (N = 1,549)</td>
<td>177 classrooms (N= 3,953)</td>
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<td>Responsive teaching</td>
<td>0.06 (0.79)</td>
<td>-0.09 (0.92)</td>
<td>0.00 (0.84)</td>
</tr>
<tr>
<td>Grade</td>
<td>3.73 (1.49)</td>
<td>2.03 (1.35)</td>
<td>3.06 (1.66)</td>
</tr>
<tr>
<td>Class size</td>
<td>22.50 (3.97)</td>
<td>22.29 (4.16)</td>
<td>22.42 (4.04)</td>
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<tr>
<td>Proportion of boys</td>
<td>.49 (.09)</td>
<td>.48 (.08)</td>
<td>.48 (.09)</td>
</tr>
<tr>
<td>Classroom SES</td>
<td>.56 (.22)</td>
<td>.54 (.25)</td>
<td>.55 (.23)</td>
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<tr>
<td>Density</td>
<td>42%</td>
<td>40%</td>
<td>44%</td>
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<tr>
<td>Reciprocity</td>
<td>42%</td>
<td>41%</td>
<td>41%</td>
</tr>
<tr>
<td>Transitivity</td>
<td>63%</td>
<td>63%</td>
<td>66%</td>
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<td>Average outdegree</td>
<td>8.46</td>
<td>8.07</td>
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<td>150.84</td>
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<td>Number of students</td>
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<td>20.83</td>
<td>20.77</td>
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<td>Respondents</td>
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<td>16.9</td>
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<tr>
<td>Missing data</td>
<td>23%</td>
<td>20%</td>
<td>22%</td>
</tr>
<tr>
<td><strong>Victimization</strong></td>
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<tr>
<td>0 (.00)</td>
<td>34%</td>
<td>30%</td>
<td>31%</td>
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<tr>
<td>1 (.01 -.20)</td>
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<tr>
<td>2 (.21 -.33)</td>
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<td>9%</td>
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<tr>
<td>3 (≥.34)</td>
<td>6%</td>
<td>7%</td>
<td>7%</td>
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cont’d
Table 1. (Continued)

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<th>Did Not Converge</th>
<th>Total Sample</th>
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<td></td>
<td>107 classrooms (N = 2,389)</td>
<td>70 classrooms (N = 1,549)</td>
<td>177 classrooms (N= 3,953)</td>
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<td>9%</td>
<td>7%</td>
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<td>Missing data per classroom</td>
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<td>2.6</td>
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<td>-0.01</td>
<td>0.02</td>
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<td>0.46</td>
<td>0.51</td>
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<td>Number stayers</td>
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<td>19.69</td>
<td>20.13</td>
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<tr>
<td>Number leavers</td>
<td>0.63</td>
<td>0.64</td>
<td>0.63</td>
</tr>
<tr>
<td>Number joiners</td>
<td>0.58</td>
<td>0.57</td>
<td>0.58</td>
</tr>
<tr>
<td>Victimization dynamics</td>
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<td></td>
</tr>
<tr>
<td>Distance</td>
<td>9.56</td>
<td>11.23</td>
<td>10.22</td>
</tr>
<tr>
<td>Percentage of stable actors</td>
<td>57%</td>
<td>49%</td>
<td>54%</td>
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<tr>
<td>Number of increasing actors</td>
<td>3.81</td>
<td>5.77</td>
<td>5.07</td>
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<tr>
<td>Number of decreasing actors</td>
<td>4.95</td>
<td>4.09</td>
<td>4.13</td>
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</table>

Note. Scores represent averages across classrooms, except for the distribution of victimization which represent the frequency of each categories across classrooms. Moran’s I represent the autocorrelations between friendship networks and victimization.
### Table 2.

**Correlation Among Classroom-Level Variables (N = 107)**

<table>
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<tr>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
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<td>0.06 (0.79)</td>
</tr>
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<td>2. Victimization at T1</td>
<td>-0.14</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.11 (0.06)</td>
</tr>
<tr>
<td>3. Victimization at T2</td>
<td>-0.17</td>
<td>0.55**</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.12 (0.06)</td>
</tr>
<tr>
<td>4. Victimization at T3</td>
<td>-0.23*</td>
<td>0.48**</td>
<td>0.75**</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>0.12 (0.05)</td>
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<tr>
<td>5. Percentage of boys</td>
<td>-0.01</td>
<td>-0.15</td>
<td>-0.22*</td>
<td>-0.15*</td>
<td>-</td>
<td></td>
<td></td>
<td>0.49 (0.09)</td>
</tr>
<tr>
<td>6. Classroom SES</td>
<td>-0.27**</td>
<td>0.20*</td>
<td>0.10</td>
<td>0.15</td>
<td>-0.07</td>
<td>-</td>
<td></td>
<td>0.56 (0.22)</td>
</tr>
<tr>
<td>7. Class size</td>
<td>-0.42**</td>
<td>0.11</td>
<td>-0.14</td>
<td>0.01</td>
<td>0.17</td>
<td>0.24*</td>
<td>-</td>
<td>22.50 (3.97)</td>
</tr>
<tr>
<td>8. Grade</td>
<td>0.03</td>
<td>-0.002</td>
<td>-0.05</td>
<td>0.04</td>
<td>-0.16</td>
<td>0.23*</td>
<td>0.16</td>
<td>3.73 (1.49)</td>
</tr>
</tbody>
</table>

*Note. Time 1 – 3 victimization scores were based on average within classroom.

* p-value < .05; **p-value < .01
Table 3.

Summary of SIENA Results from Meta-Analytic Random-Effects Model (N = 107 Classrooms)

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>Estimate</th>
<th>SE</th>
<th>z-value</th>
<th>95% CI</th>
<th>( \hat{\tau}^2 )</th>
<th>SE ( \hat{\tau}^2 )</th>
<th>k</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friendship dynamics</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdegree</td>
<td>0.25</td>
<td>-1.41***</td>
<td>0.03</td>
<td>-44.23</td>
<td>-1.47</td>
<td>1.34</td>
<td>.057</td>
<td>.01</td>
<td>107</td>
</tr>
<tr>
<td>Reciprocity</td>
<td>1.14</td>
<td>0.13***</td>
<td>0.03</td>
<td>3.97</td>
<td>0.06</td>
<td>0.19</td>
<td>.049</td>
<td>.01</td>
<td>107</td>
</tr>
<tr>
<td>Transitive triplets</td>
<td>1.13</td>
<td>0.13***</td>
<td>0.00</td>
<td>28.04</td>
<td>0.12</td>
<td>0.13</td>
<td>.001</td>
<td>.00</td>
<td>107</td>
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<tr>
<td>Same gender</td>
<td>1.77</td>
<td>0.57***</td>
<td>0.02</td>
<td>26.48</td>
<td>0.53</td>
<td>0.61</td>
<td>.019</td>
<td>.01</td>
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<td>0.94</td>
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<td>0.02</td>
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<td>-0.11</td>
<td>-0.02</td>
<td>.017</td>
<td>.01</td>
<td>107</td>
</tr>
<tr>
<td>Victim similarity</td>
<td>1.75</td>
<td>0.56***</td>
<td>0.08</td>
<td>6.66</td>
<td>0.40</td>
<td>0.72</td>
<td>.160</td>
<td>.08</td>
<td>107</td>
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<tr>
<td>Victimization dynamics</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear shape</td>
<td>0.91</td>
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<td>-2.21</td>
<td>-0.17</td>
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<td>Quadratic shape</td>
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<td>-4.38</td>
<td>-0.32</td>
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<td>.034</td>
<td>.03</td>
<td>107</td>
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<tr>
<td>Victimization contagion</td>
<td>2.75</td>
<td>1.01***</td>
<td>0.19</td>
<td>5.20</td>
<td>0.63</td>
<td>1.40</td>
<td>.000</td>
<td>.31</td>
<td>107</td>
</tr>
</tbody>
</table>

*Note.* \( \hat{\tau}^2 \): estimated amount of residual heterogeneity; SE \( \hat{\tau}^2 \): estimated standard error of the estimated amount of residual heterogeneity; k: number of classrooms included in the model fitting; \( Q \): Cochran’s \( Q \) test statistics for the test of residual heterogeneity. Odds ratios can be computed by taking the exponential function of the parameter estimates.

\* *p*-value < .05; ** *p*-value < .01; *** *p*-value < .001
Table 4.

*Results from Meta-Analytic Mixed Effects Model*

<table>
<thead>
<tr>
<th></th>
<th>Friendship dynamics</th>
<th>Victimization dynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Outdegree</td>
<td>Reciprocity</td>
</tr>
<tr>
<td><strong>Model 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsive Teaching</td>
<td>0.09*</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>0.00</td>
<td>0.02</td>
</tr>
<tr>
<td>R²</td>
<td>5.77%</td>
<td>0.00%</td>
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<tr>
<td><strong>Model 2</strong></td>
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</tr>
<tr>
<td>Responsive Teaching</td>
<td>0.09*</td>
<td>0.05</td>
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<td></td>
<td>0.00</td>
<td>0.02</td>
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<tr>
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<tr>
<td>R²</td>
<td>4.36%</td>
<td>0.00%</td>
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</table>

*Note. τ²: estimated amount of residual heterogeneity, R²: amount of heterogeneity accounted for*
### Table 5.
**Predicted Log Odds and Odds Ratio based on Meta-Analytic Mixed Effects Model 2**

<table>
<thead>
<tr>
<th>Predicted Log Odds</th>
<th>Predicted Odds Ratio (OR)</th>
<th>Predicted OR 95% CI</th>
<th>Intercept</th>
<th>RT</th>
<th>Grade</th>
<th>Size</th>
<th>Percent of boys</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Outdegree</td>
<td>-1.61</td>
<td>0.20</td>
<td>0.16</td>
<td>0.25</td>
<td>-2.43</td>
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<tr>
<td></td>
<td>-1.52</td>
<td>0.22</td>
<td>0.19</td>
<td>0.25</td>
<td>-1.43</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>-1.42</td>
<td>0.24</td>
<td>0.22</td>
<td>0.26</td>
<td>-1.19</td>
<td>-0.43</td>
<td>3.73</td>
<td>22.50</td>
</tr>
<tr>
<td></td>
<td>-1.33</td>
<td>0.27</td>
<td>0.24</td>
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<td>-1.23</td>
<td>0.29</td>
<td>0.25</td>
<td>0.34</td>
<td></td>
<td>1.57</td>
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<tr>
<td>(b) Transitivity</td>
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<td>1.24</td>
<td>-2.43</td>
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<tr>
<td></td>
<td>0.16</td>
<td>1.18</td>
<td>1.15</td>
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<td>3.73</td>
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Table 5. (Continued)

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<th>Predicted Odds Ratio (OR)</th>
<th>Predicted OR 95% CI</th>
<th>Intercept</th>
<th>RT</th>
<th>Grade</th>
<th>Size</th>
<th>Percent of boys</th>
<th>Class SES</th>
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<td>(f) Victim Similarity</td>
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<td>3.73</td>
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<tr>
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</tr>
</tbody>
</table>

Note. RT: responsive teaching.

Predicted Log Odds = Intercept + β_{RT}RT + β_{grade}*Grade + β_{size}*Size + β_{percent_boys}*Percent of boys + β_{class SES}*Class SES, where βs can be found in Table 4 Model 2. For example, for RT = -2.43, the predicted log odds for Outdegree holding everything else at the mean = -1.19 + 0.09*(-2.43) + (-0.01)*3.73 + (-0.01)*22.50 + 0.07*0.49 + 0.12*0.56 = -1.57 (the result was slightly different from the one reported on the table, -1.61, due to rounding). The predicted odds ratio = EXP(-1.57) = 0.208
Figure 1. Percentage of children, from those who were never named as victims to those who were highly victimized, at each time point in classrooms with low (N = 35 classrooms), moderate (N = 38), and high (N = 34) responsive teaching. RT = Responsive Teaching.
Appendix: Supplementary Materials

Model Building and Convergence Issues

In this section, I described a model building algorithm that was used to identify reasons for non-convergence and develop strategies to retain as many classrooms as possible for analyses. After running SIENA model in each classroom, model convergence was checked using the following new criteria: \( t \)-convergence \( \leq 0.10 \) for each SIENA parameter and an overall \( t \)-convergence \( \leq 0.25 \) (Ripley et al., 2016). Classrooms that did not satisfy these criteria were re-estimated using the standard initial value. If convergence was close to the required value, estimation was continued using ‘prevAns’ command to obtain better convergence. The final set of classrooms that converged were included for further model building.

Figure A.1 summarizes the model building algorithm. I started with modeling only the friendship network dynamics using two structural effects: outdegree and reciprocity (Model 1). Classrooms that do not converge at this stage indicate that there are issues in the structures of the friendship networks. For example, there might be too many missing data in friendship nominations or not enough changes in friendship ties from wave to wave. All 177 classrooms converged at this stage. In the next step, I included a triadic closure effect called transitive triplet (Model 2). A significant drop in the number of converging classrooms at this stage would indicate that transitive triplet may not be the most appropriate effect to model triadic closure in the current sample. In that case, one solution is to substitute transitive triplet with a less stringent effect called GWESP (Ripley et al., 2016 section 6.2). Only 1 classroom (120311) did not converge when transitive triplet was included in the model, whereas 30 classrooms did not converge with GWESP effect. Thus, I proceeded with the model that used transitive triplet and added effects related to victimization in the next step (Model 3): (1) victim alter, (2) victim
similarity, and (3) average alter. At this stage, I ran separate models using six different transformation strategies: tertiles, quartiles, ± 0.5SD, dichotomous variables using 0.15 cut-scores, dichotomous variables using 0.20 cut-scores, and the 4-point victimization scale using 0.20 and 0.34 cut scores. One of the reasons for trying different transformation strategies was to test the robustness of results. Another reason was that the behavior variable (in this case, victimization) needs to be recoded so that changes between observation points are more regular (Riplet et al., 2016). However, there is yet a clear measure like Jaccard index to quantify such “regular changes.”

As shown in Figure A.1, the number of classrooms that converged depends on the kind of transformations used in the model, with the 4-point scale transformation using 0.20 and 0.34 cut-scores led to the maximum number of retained classrooms (60% of the sample). This transformation was used in the current study. In all of these cases, the rate parameter for victimization at period 1 and period 2 were especially the causes of difficulties of convergence. These rate parameters represent the rate of micro changes in victimization between time points. Poor convergence for these parameters indicates irregularity in the dynamics of victimization over time. One solution suggested by Ripley et al (2016) is to fix these rate parameters at a very large value for which the $t$-convergence is also acceptable. I tried to fix these parameters at the top 10% and top 5% of the parameter values from the set of converging classrooms, but while the overall $t$-convergence improved, $t$-convergence for these rate parameters remained larger than 0.10.
Figure A.1. Model building algorithm.
References


Mashburn, A. J., Pianta, R. C., Hamre, B. K., Downer, J. T., Barbarin, O. A., Bryant, D., ... &


