HOW DO ELEMENTARY SCHOOL TEACHERS SHAPE CHILDREN’S SOCIAL DEVELOPMENT?

A STUDY OF TEACHERS’ USE OF SEATING ARRANGEMENTS AND RESPONSIVE TEACHING

A Dissertation in
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by
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ABSTRACT

The elementary school classroom has long been recognized as an important context for children’s social development. Because of their unique role in the classroom, teachers may be able to shape children’s peer relationships and social behavior even in the absence of direct social skills training. The present dissertation aimed to identify teaching behaviors and strategies that may be important influences on children’s social development. This dissertation consists of two related papers, each exploring a single mechanism by which teachers were expected to influence children’s social interactions and relationships. The first paper uses classroom seating charts to explore how seating arrangements are associated with changes in children’s aggressive and prosocial behaviors across several months. The second paper examines whether teachers who are highly responsive to their students promote the development of high-quality classroom relationships within a single school year. Both studies capitalize on the rich data collected as part of the Classroom Peer Ecologies Project, a study of teaching practices, peer ecologies, and child outcomes.

Results from the first paper suggest that seating arrangements may be a meaningful factor in the development of children’s social behavior. Children who were initially aggressive had more severe behavior problems when classrooms were arranged as groups rather than rows. Popularity played an important role: In classrooms arranged as groups, less-aggressive children tended to become more similar to their aggressive seatmates, but only if seatmates were popular. Children who were unpopular were especially likely to adopt the prosocial behavior of their seatmates. Results from the second paper indicate, first, that subjecting classroom observation data to a bifactor analysis reveals a common factor which we labeled Responsive Teaching. Second, having highly responsive teachers protected children in aggressive contexts from developing low-quality relationships with their teachers and peers. Overall, this dissertation shows the value in understanding how the teacher may use both direct and indirect teaching strategies to manage the classroom. Results also underscore the importance of children’s daily interactions with teachers and classmates, rather than just children’s friends and peer group members.
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Using a sample of hundreds of children, this dissertation showed that social interactions matter. In reality, writing this dissertation provided me with all of the anecdotal data I needed to say that social support and peer interactions are powerful forces in our lives.

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Chapter 1

Introduction

The elementary school classroom has long been recognized as an important context for children’s social development (Gronlund, 1959; Cairns & Cairns, 1994; Maddox & Prinz, 2003). In recent years, research on children’s social development in the classroom has frequently addressed two themes. First, researchers have focused on understanding the causes and consequences of children’s aggressive and disruptive behaviors (e.g., Farmer, 2000; Gest, Welsh, & Domitrovich, 2005). Aggressive behaviors can seriously impact the teacher’s ability to teach and the quality of the classroom experience for other children (Klassen & Chiu, 2010; Buhs, Ladd, & Herald, 2006; Juvonen, Wang, & Espinoza, 2011). A second area of research has explored how children’s sense of relatedness, or belonging, develops in the classroom, and has identified outcomes for which relatedness is especially important (Baumeister & Leary, 1995; Furrer & Skinner, 2003). This research suggests that feeling a sense of community in the classroom and having a closer relationship with one’s teacher contributes to children’s behavioral engagement in the classroom and their intrinsic motivation for learning (Battistich, Solomon, Kim, Watson, & Schaps, 1995; Hughes, 2011; Furrer & Skinner, 2003).

Though these two domains of social development may appear distinct, research suggests that both outcomes, in part, have origins in children’s regular interactions in the classroom (O’Connor, 2010; Farmer, 2000). According to a bioecological perspective on human development, these social interactions, known as proximal processes, are key to the transmission of knowledge and behavior from one individual to another (Bronfenbrenner & Morrison, 2006). For example, a child who interacts frequently with other aggressive children, as in the context of a close friendship, is likely to increase in aggressive behavior (Brechwald & Prinstein, 2011).
Teachers’ warm, supportive interactions with children have been associated with more positive peer interactions, perhaps because teachers are providing daily examples of a positive interaction style (Mikami, Gregory, Allen, Pianta, & Lun, 2011).

As this last point clearly illustrates, the teacher can have a powerful influence on the complex network of ties between students in a classroom, often referred to as the peer ecology (Rodkin & Hodges, 2003). The ability to shape children’s social interactions and relationships—whether intentionally or not—is often described as the teacher’s “invisible hand” (Cairns & Cairns, 1994; Farmer, 2000; Gest & Rodkin, 2011). The teacher’s unique vantage point just outside of the peer ecology allows the teacher to closely observe the development of relationships in the classroom and perhaps intervene (Rodkin & Hodges, 2003).

Researchers have suggested a number of ways that teachers affect children’s social interactions and relationships without providing direct social skill training. According to Gest and Rodkin (2011), approaches can be classified as either specific management strategies or general teaching practices. Specific strategies are those in which teachers actively manipulate children’s potential for interactions in order to achieve a specific social goal. A behavioral psychology perspective suggests that strategies that reduce opportunities for provocation and reinforcement for aggression should improve children’s behavior (Lane, Walker, Crnobori, Oliver, Bruhm, & Oakes, 2012). A social-cognitive theory of development further suggests that children may model other children’s aggressive behavior (Bandura, Ross, & Ross, 1963). As such, teachers should select positive models for aggressive children (Farmer & Cadwallader, 2000).

Only recently has research begun to consider how general teaching strategies might indirectly affect children’s social relationships. Gest and Rodkin (2011) suggested teachers
interact with students in a warm, caring way, creating a positive environment that encourages prosocial interactions among children. Mikami and colleagues (2011) suggested an additional process, in which children imitate teachers’ warm interactions when interacting with their peers, resulting in positive social interactions among children. Neither hypothesis has been empirically tested.

Although the research on teachers’ role in managing social interactions is growing, it is still limited. Many of the existing recommendations for teachers lack empirical evidence. Furthermore, recommendations often do not build on practices that teachers already implement, such as arranging students in a seating chart. Finally, there is a need to identify aspects of teacher-child interactions that are beneficial for children’s social relationships. Currently, research on teacher-child interactions has focused largely on improving children’s academic outcomes (e.g., Pianta, Belsky, Vandergrift, Houts, & Morrison, 2008).

Two Studies on the Teacher’s “Invisible Hand”

To address the limitations in the existing research, the studies in this dissertation capitalize on the rich data collected as part of the Classroom Peer Ecologies Project, a study of teaching practices, peer ecologies, and child outcomes (see Gest & Rodkin, 2011). Data were collected from elementary school classrooms in the form of classroom observations, teacher surveys, and child surveys. Each study in this dissertation addressed one mechanism by which teachers were hypothesized to play a role in managing children’s social interactions, relationships, or sense of relatedness in the classroom. A basic conceptual model of the two studies, as well as the overarching goal of the Classroom Peer Ecologies Project, is presented in Figure 1 (Rodkin & Gest, 2010).
Study 1 builds on the evidence that friends are an important source of influence on a child’s aggressive behavior by considering the potential for a child’s seatmates to influence his or her aggressive behavior (Path B in Figure 1). This study addresses an important gap in the literature, as teachers regularly make decisions about the seating placements of children without strong research to guide them. An additional benefit of this study is its contribution to research on peer influence. Currently, studies suggest that deviant peers have the largest influence on a child’s deviant behavior when they spend large amounts of unstructured, unsupervised time together (Dishion & Tipsord, 2011). If evidence were to indicate that seatmates are, indeed, sources of influence, it would suggest that peer influence can also occur in structured, supervised environments.

Whereas the first study addresses teachers’ specific strategies for managing children’s interactions and relationships, Study 2 examines how teachers’ general teaching practices might foster a sense of relatedness in their classroom (Path A in Figure 1). Specifically, Study 2 uses the CLASS, a well-known measure of teacher-child interaction quality (Pianta, La Paro, & Hamre, 2008), to isolate specific aspects of teachers’ interactions with students that might facilitate the formation of close teacher-child relationships as well as a sense of community among students. Recent evidence suggests that the extent to which teachers are responsive to children’s interests and needs is a key factor in a wide range of developmental outcomes, ranging from the quality of relationship with preschool teacher to growth in language and literacy skills across preschool (Hamre, Hatfield, Pianta, & Jamil, 2014).

This dissertation employs a variety of methodological strategies to understand the various teaching strategies being considered. Study 1 takes advantage of a large sample of classroom seating charts to understand whether children’s seatmates influence their behavior. It is rare to
have the combination of behavioral data and indices of physical proximity that make Study 1 possible. Study 2 uses a bifactor modeling approach to score a well-known scale of teacher-child interactions. This approach allows us to identify orthogonal factors characterized by different types of interactions. Both studies employ multilevel modeling to account for the nesting of children within classrooms.

Taken together, the studies in this dissertation are expected to make a meaningful contribution to the existing literature on teacher and peer influences on social development. Moreover, the results of this dissertation will also have important practical implications, providing a foundation for the development of a comprehensive classroom management intervention that can later be subjected to rigorous, experimental research.
References


Figure 1. Overview of the two studies in the dissertation. Study 1 addresses path B. Study 2 addresses path A. Figure is adapted from Rodkin and Gest, 2010 (p. 17).
Chapter 2

Study 1: Seating Arrangement as a Context for Peer Influence on Aggressive and Prosocial Behavior

Managing children’s behavior in the classroom is a major concern for teachers (Ingersoll & May, 2012). Increasingly, behavior management recommendations in elementary schools include a focus on children’s relationships and interactions with peers (Farmer, Goforth, Hives, Aaron, Jackson, & Sgammato, 2006). There is strong evidence that children become more like their friends and peer group members over time, even after accounting for the children’s selection of similarly-behaved peers (Dishion & Tipsord, 2011; Brechwald & Prinstein, 2011). In general, studies of non-clinical populations have focused on the role that self-selected peers, such as friends and clique members, play in children’s aggressive and prosocial behavior (e.g., Brechwald & Prinstein, 2011; Molano, Jones, Brown, & Aber, 2013). Spending time with self-selected peers is predictive of increases in disruptive behaviors as early as preschool (Snyder, Horsch, & Childs, 1997). During adolescence, the amount of time spent in unsupervised, unstructured settings with self-selected peers positively predicts the acquisition of delinquent behaviors (Haynie & Osgood, 2005). Aside from studies of aggressive children who are aggregated for small-group behavioral interventions (Dishion & Tipsord, 2011), few attempts have been made to understand whether children’s interactions with peers who are not self-selected—and which occur in well-supervised and structured settings—might also influence children’s aggressive and prosocial behaviors. The present study considers the potential for peer influence in one such context: the classroom seating arrangement.

There is a surprising scarcity of research on the effects of seating proximity, given that children spend hours per day with these peers. What’s more, seating arrangements are one of the
few sources of peer interaction that are easily manipulated. For example, a recent intervention demonstrated that overall classroom relationship quality was improved when children who disliked each other were moved closer together (van den Berg, Segers, & Cillessen, 2012). The aim of the present study was to understand whether classroom seating arrangements were associated with changes in children’s aggression and prosocial behavior. Specifically, the study examined changes in children’s behavior as a function of the physical arrangement of seats, as well as the aggressive and prosocial behaviors of adjacent children (“seatmates”).

**Research on Seating Arrangements and Children’s Behavior**

Research on classroom seating arrangements can be divided into two categories: (1) studies examining the effects of the physical arrangement of seats in a classroom (typically rows versus groups of desks), and (2) studies examining the effects of sitting next to a particular seatmate. The majority of research falls in the first category, with the focus being on how arrangements affect children’s on-task or disruptive behavior during class time (e.g., Bicard, Ervin, Bicard, & Baylot-Casey, 2012; Wannarka & Ruhl, 2008). Still, compared to the extensive body of research on peer influence through friendships and peer groups (e.g., Brechwald & Prinstein, 2013), this body of work is small. For example, in reviewing the existing literature on groups versus rows and children’s disruptive/off-task behavior, Wannarka and Ruhl (2008) found only eight relevant studies.

Within just this small body of work, there is a strong consensus that group arrangements are associated with more disruptive behavior and less on-task behavior, compared to seating arrangements where children are seated individually, such as rows or columns (see Wannarka & Ruhl, 2008, for a review). For example, Bicard and colleagues (2012) found that group arrangements were associated with greater incidence of children talking out of turn and touching
each other during an individual seatwork assignment. However, studies in this area are small, often examining just one or two classrooms (e.g., Bicard et al., 2012; Axelrod, Hall, & Tams, 1979). Furthermore, no studies have linked the physical arrangement of seats to children’s physical or social aggression, or to increases in helping behavior and cooperation.

Even fewer studies have examined the effects of sitting next to particular seatmates, despite the fact that many teachers report that they intentionally separate children likely to cause problems (Gest & Rodkin, 2011). Citing the role of peer interactions and peer relationships for supporting problem behavior, some researchers explicitly suggest that teachers use seating charts to separate children and weaken negative social relationships (Pearl, Leung, van Acker, Farmer, & Rodkin, 2007). Results from one small study suggest that this tactic may be useful: Bicard and colleagues (2012) compared student behavior during student-selected seating arrangements and teacher-selected seating arrangements in two 5th grade classrooms. Teachers were told to arrange the students as they wished, including separating children known to be disruptive when seated together. Children exhibited fewer disruptive behaviors when they were seated in the teacher-selected arrangements, supporting the notion that separating particular students might reduce disruptive behavior. Additional evidence that seating proximity is a meaningful area of study for children’s social development comes from Gest and colleagues (2013), who showed that elementary-aged children were slightly more likely to become friends when they were at adjacent seats.

To our knowledge, no studies have examined the role of a child’s seatmate(s) in the development of the child’s aggressive and prosocial behavior. Further, it is not clear whether placing aggressive children with non-aggressive “role models” might have the unintended consequence of increased aggression for the non-aggressive child.
Mechanisms of Seatmate Influence on Behavior

The increase in disruptive and off-task behavior in group arrangements has been attributed to several factors, including the increased opportunity for conversation, the ease of obtaining others’ attention during class time (by simply looking at classmates), and the greater likelihood that disruptive behaviors will spread to others, compared to row arrangements (Axelrod et al., 1979; Bicard et al., 2012). Arranging seats as rows can therefore be thought of as a setting event, or a way to shape the classroom to prevent undesirable behaviors from happening in the first place (Wannarka & Ruhl, 2008). The present study focused not on disruptive behaviors that occurred only during class time, but on the development of social behaviors across various settings. Group arrangements were seen as catalysts for the spread of aggressive and prosocial behaviors: For all of the mechanisms described below, group seating arrangements are expected to make the transmission of behavior more likely.

Several mechanisms have been proposed to explain the increasing similarity between children and their friends or peer group members (Kindermann, 2007). Explanations that stem from behavioral perspectives and social learning theories provide the most reasonable explanations for influence in the context of seating arrangements (e.g., Brechwald & Prinstein, 2011; Farmer, Reinke, & Brookes, 2013). These theories focus on children’s observations of others and interactions with peers. Despite the structured setting and supervision of a classroom, children actually have a number of interactions during class time—when one would assume they are in assigned seats. For example, in their sample of 4th and 7th graders, Gest, Farmer, Cairns, and Xie (2003) found children interacted with members of their peer group about three times per hour, with additional interactions with non-group members nearly once an hour. In fact, their
pilot work showed that children actually had more interactions during class time than during transition times.

Below, the most relevant mechanisms are briefly described in terms of their potential for influence in seating arrangement. Although the specific effects of these mechanisms cannot in the present study, identifying the mechanisms justifies the present study’s exploration of peer influence in classrooms seating arrangements.

**Antecedents.** An antecedent is a condition that evokes a behavior of interest (Lane, Walker, Crnobori, Oliver, Bruhn, & Oakes, 2012). By taunting, teasing or otherwise provoking one another, peers serve as antecedents to aggression (Farmer, 2000). Initiating an aggressive interaction on the playground, for example, is much more likely to be followed by an aggressive response from peers than by a prosocial response (Pepler, Craig, & Roberts, 1998). Being constantly provoked by peers can lead some children to retaliate on a regular basis; such is the case for children described as “bully-victims” (Giang & Graham, 2008). Children sitting together have many opportunities to provoke one another. Similar to playmates at recess, seatmates have the opportunity to physically provoke one another as well as to verbally taunt or attack one another.

**Reinforcement.** Children’s aggressive behaviors can be reinforced by their peers’ reactions in a process known as deviancy training (Dishion & Tipsord, 2011). Dishion, Spracklen, Andrews, & Patterson (1996) found that deviant boys responded to one another’s talk about deviant behaviors with laughter, which reinforced the deviant talk. In contrast, non-deviant boys reinforced talk about normative topics such as school and family. Most importantly, having friends who reinforced deviant talk predicted a greater increase in delinquency across two years.
Seatmates who are aggressive might also provide reinforcement for aggressive behaviors. That is, if a child teases another child, trips a student walking by, or talks back to the teacher, his or her seatmate might laugh or smile, reinforcing the behavior. Prosocial seatmates, in turn, should not be expected to reinforce aggressive behavior, and may actually reinforce positive behavior. In one small study of four boys with behavior problems, Broussard and Northup (1997) found that the boys were reinforced primarily by peer attention, rather than teacher attention; when classmates were told not to pay attention to the boys when they acted out, the problem behavior was significantly reduced.

**Modeling.** It may not be necessary for the focal child to experience provocation or reinforcement directly; instead, social-cognitive theory allows for influence to occur through observation of others’ behaviors (Bandura, 1986). Moreover, the observed consequences to the model can determine whether the focal child adopts the behavior. Through this process of *vicarious learning*, children learn which behaviors are acceptable (Bandura, Ross, & Ross, 1963). Many studies cite observational learning as a likely explanation for increasing similarity among peer group members (e.g., Boxer, Guerra, Huesmann, & Morales, 2005; Shi & Xie, 2012). For example, Shi and Xie (2012) found that children’s behavior was most influenced by their group members who had high social status, suggesting that children imitate aggressive behavior with the expectation that they, too, will receive high social status.

In one of the few studies of behavior change as a function of a particular seatmate, researchers trained a teacher to reinforce one misbehaving first grade boy when he used appropriate behavior. This intervention led to improvements in the behavior of his seatmate, also a disruptive child (Broden, Bruce, Mitchell, Carter, & Hall, 1970). In the typical classroom, however, aggressive behaviors are much more likely to spread than are prosocial behaviors
(Molano et al., 2013). It may be that observational learning allows children to learn new aggressive tactics from their seatmates, and to determine whether they are likely to be reinforced for these behaviors. In short, children might receive deviancy training vicariously: When a seatmate gets a positive reaction from classmates for his or her aggressive behavior, the child models the behavior.

**Potential Moderators of Seatmate Influence**

**Grade differences in susceptibility to influence.** In early grades, children likely spend a good amount of time in centers, on the rug, in reading groups, and on the playground. In contrast, the increasing importance of direct instruction and independent seatwork in upper grades suggests that older children may spend more time in the company of their seatmates. As a result, seatmate influence might be stronger in upper-elementary grades.

**Gender differences in susceptibility to influence.** Several studies have found boys to be more susceptible to peer influence on aggression (Kellam, Ling, Merisca, Brown, & Ialongo, 1998; Stormshak, Bierman, Bruschi, Dodge, & Coie, 1999). For example, Kellam and colleagues (1998) found that classroom-level aggression in 1st grade predicted aggressive behavior in 6th grade for boys only. One explanation is that the social rewards of physical aggression are stronger for boys than for girls (Stormshak et al., 1999). Girls, in turn, may perceive greater potential reward for the use of relational aggression.

**Baseline aggression and susceptibility to influence.** Children who already exhibit aggressive behavior appear to be more susceptible to peer influence on aggression (Kellam et al., 1998). Aggressive children tend to interpret ambiguous interactions as having a hostile intent and are more likely to pick up on peers’ aggressive cues (Coie & Dodge, 1987). Given this evidence, a target child who is already aggressive might have the greatest increase in aggression as a result
of having aggressive seatmates. Indeed, Molano and colleagues (2013) found that children with a 
hostile attribution bias showed greater increase in aggression as a result of having aggressive 
group members, compared to children without such bias. Furthermore, there would be no 
opportunities for reinforcement for aggression if the target child does not initially discuss 
delinquent topics or use aggressive tactics.

In addition to being most influenced by aggressive seatmates, aggressive children might 
also reap great rewards from sitting next to nonaggressive children (Boxer et al., 2005; Adams, 
Bukowski, & Bagwell, 2005). For example, Adams and colleagues found that highly aggressive 
children with an aggressive friend were still aggressive six months later, but aggressive children 
with a non-aggressive friend decreased in aggression. Similarly, research on seating 
arrangements has shown that children who had the least on-task behavior benefited the most 
from row seating arrangements, as opposed to group seating arrangements (Hastings & 
Schwieso, 1995).

**Social status of focal child and seatmates.** Popular youth have power and influence; in 
peer groups, they establish the behavioral norms, fostering group cohesion and homogeneity 
(Bukowski, 2011; Sandstrom, 2011). Children who are low in status may be especially 
susceptible to peer influence and reinforcement for deviant behaviors because they lack attention 
from peers (Snyder et al., 2010). Shi and Xie (2012) found that low-status boys were most 
affected by high-status group members’ aggressive behavior; however, for girls, high-status 
group members’ aggression was most predictive of aggression in other high-status girls. In short, 
it appears that a desire to achieve status promotes the adoption of aggressive behaviors, though 
the effect may be more complex for girls.
A seatmate’s potential to influence might be affected by his or her own status. Shi and Xie (2012) found that high-status group members’ social aggression predicted social aggression 6 months later, whereas low-status group members had no effect. For physical aggression, the effect of high-status peers was found for boys only. Shi and Xie suggested that children changed their behavior to align with behavioral norms, which are set by high-status members of a community. Given the power of popular peers, popular seatmates were expected to be especially influential.

The Present Study

The overarching goal of the present study was to examine how classroom seating arrangements and the characteristics of seatmates were associated with changes in children’s aggressive and prosocial behavior during a single school year. Behaviors was assessed twice: once within two months of the beginning of the school year (Time 1; T1) and again approximately two months later (Time 2; T2). Seating charts were obtained at T1.

**Aim 1: Physical arrangement of seats predicting change in behavior.** The first aim of the study was to understand how two different physical arrangements of the classroom—group arrangements and traditional row arrangements—were differentially associated with changes in children’s behavior across a period of several months. It was expected that after accounting for initial levels of aggression, children in group arrangements would be more aggressive than children in row arrangements. The strongest effects were expected to be for children who had initially high levels of aggression. This hypothesis was based on the expectation that children in group arrangements would have more antecedent conditions as well as more opportunities for peers to reinforce their existing aggressive behaviors. It was also expected the effects of seating
arrangement would be strongest for upper grades, given that these students spend more time in their seats.

Similar moderation hypotheses were made for the prediction of prosocial behaviors. Groups should facilitate teamwork and discussion, providing opportunities to be prosocial and to be reinforced for prosocial behavior. Thus, it was expected that group arrangements would result in greater prosocial behavior, especially among those children who were initially prosocial. Again, the effect of seating arrangement was expected to be strongest for children in upper grades.

**Aim 2: Seatmate behavior as a predictor of changes in children’s behavior.** The second aim of this study was to examine whether the behavior of a child’s seatmates predicted changes in children’s aggressive and prosocial behavior. It was expected that, after controlling for children’s aggression at T1, seatmate aggression at T1 would predict children’s aggression at T2. Furthermore, it was expected that the influence of seatmate aggression would be strongest for boys and for children who were initially aggressive. The same hypothesis was made for prosocial behavior: Children with prosocial seatmates were expected to increase in their prosocial behavior, and the effects were expected to be strongest for boys and children who were initially prosocial. These effects were expected to be strongest in group arrangements, but smaller or non-existent in row arrangements. Seatmate influence was expected to be stronger in upper grades. We also explored whether the pattern of influence from seatmate to focal child depended on the popularity of the seatmates or of the target child. Specifically, it was expected that unpopular target children would be more receptive to seatmate influence, and the greatest seatmate influence was expected to occur from popular seatmates.

**Methods**
Participants

Data were analyzed for 1164 children (51% boys) in grades 1, 3, and 5 (526 1st graders, 337 3rd graders, and 570 5th graders). Children were drawn from the Classroom Peer Ecologies Project, a multi-year study of teaching practices, peer relationships, and student outcomes. Each year, a set of classrooms was followed from fall to spring with the broad goal of understanding influences on children’s development within a single school year. To provide a diverse sample, school districts were drawn from rural areas, small-to mid-sized cities, and urban areas in the Northeast and Midwest of the United States.

The present study included classrooms assessed during Years 2–4 of the project. The original sample included 124 classrooms from 20 schools; however, two classrooms dropped out before the end of the year. Fifty-four additional classrooms were excluded because they did not meet the requirements for these analyses: 18 classrooms did not provide seating charts, 16 classrooms had unusable seating charts (see below), 15 classrooms used seating arrangements that were not tables, groups, rows, or columns (e.g., “E”-shaped arrangements; horseshoes), and four classrooms had low participation (< 65% of students participated at T1). Participation rates of 65% or greater were required because accurate peer-nominated behavior scores rely on a substantial proportion of students participating.

The final sample included 70 classrooms from 20 schools (30 1st grade, 17 3rd grade, and 23 5th grade). Classrooms composition varied widely. The average classroom was 45% minority ($SD = 32\%$, range $0\%–100\%$) and had 55% of students coming from families where neither parent had a college degree ($SD = 20\%$, range $13\%–100\%$).

Procedures
Teachers were approached regarding the study and provided informed consent if they agreed to participate. Parents then received information about the study and provided consent for their child to participate. Children provided oral assent (first grade) or written assent (third and fifth grade) prior to taking the survey. The assessments used in the current analyses were collected at two time points: T1 data were collected within two months of the first day of school, and T2 data were collected approximately two months later. Teachers and students completed surveys at each time point.

In third- and fifth-grade classrooms, trained research assistants read survey questions aloud and children were asked to indicate their responses on their surveys. In fifth grade, children were individually interviewed by trained research assistants, who indicated children’s responses on the survey forms. Teacher surveys were given to teachers around the same time as student surveys were administered.

**Longitudinal sample**

Consent rates were high: Of the 1446 children who were enrolled at T1, parent consent was provided for 1275 children (87%). Of the 1275 consented children, 1249 were still enrolled in the same classroom at T2. Of these, 1189 had at least one seatmate at T1. Finally, ethnicity was unknown for 25 of children, resulting in a final analytic sample of 1164 children. Peer-nominated behavior was reported by the children who also provided assent to participate in the survey. At T1, 84% of enrolled children provided assent and participated in the peer-nomination measures. At T2, the rate was 85%.

**Measures**

**Seatmates and seating arrangement.** Seating charts were obtained using slightly different methods each year of the study. In Year 2, teachers were first asked to indicate the type
of seating arrangement as rows, tables, clusters of desks, or other. Teachers were asked to
describe the type of “other” arrangement where applicable. Teachers then wrote the names of
students into provided columns to indicate the placement of children in the seating arrangement.
In Years 3 and 4, the survey was revised to allow teachers to draw their seating arrangement and
write in children’s names (see Figure 1). From these drawn seating charts, the type of
arrangement (e.g., rows, tables, clusters of desks, u-shape) was determined by research
assistants.

Seatmates were identified as those students sitting nearest to the focal child. For example,
Figure 1 shows a hypothetical classroom arranged with desks in rows. In this arrangement,
children could have a maximum of two seatmates (children on the left and right). Children who
were separated by an aisle were not considered to be seatmates.

In Year 2, the column format made it difficult to determine adjacency for children. The
only formats in which all adjacencies could be determined were clusters of desks or tables, as
long as no more than four children were included. (In such arrangements, all children are
adjacent.) Classrooms arranged as rows or tables/desk clusters with more than four children were
excluded. The format in Years 3 and 4 allowed adjacency to be easily identified regardless of the
arrangement of desks.

Finally, seating arrangement categories were consolidated into groups (tables, desk
clusters), rows (rows, columns), or other (e.g., u-shape, “E”-shape, rectangle). Only classrooms
arranged as groups or rows were included in the present analyses.

**Peer nominations of aggressive and prosocial behavior.** At T1 and T2, participating
children provided peer nomination data. To assess aggressive behavior, children were asked to
identify classmates who fit the descriptions for two items: “These kids start FIGHTS. These kids
push other kids around, or hit them or kick them” and “These kids SAY MEAN THINGS about other kids, and they spread nasty rumors about other kids” ($r_{t1} = .82; r_{t2} = .81$). Two items assessed prosocial behavior: “These kids are always will to do something NICE for somebody else, and are really nice people” and “These kids COOPERATE. Here are kids who really cooperate—they pitch in, share, and give everyone a turn” ($r_{t1} = .82; r_{t2} = .80$). Class rosters were provided for 3rd and 5th graders to circle names; 1st graders recalled names from memory. Children could name as many classmates as they desired. Both items were transformed into proportion scores by dividing the number of nominations that a child received by the total number of participating children in the classroom. The proportion scores from each item were averaged to create a composite aggression score.

**Peer ratings of popularity.** Two peer-nomination items assessed perceived popularity at T1: “These are the most POPULAR kids in my class” and “These are the kids in my class who are NOT POPULAR” ($r = -.43$). After transforming items to proportion scores, a composite score was calculated as the difference between “popular” minus “not popular.” Popular children were those with a score greater than 0; all other children were considered unpopular.

**Seatmate behavior.** For each child, seatmate behavior scores were created by computing the average aggression and prosocial scores of all seatmates at T1. Additionally, the average aggression and prosocial scores were identified for all popular seatmates as well as all unpopular seatmates. The latter two categories of seatmate behavior were necessary for exploring the moderation hypothesis that popular seatmates were more influential that unpopular seatmates. Each target child therefore had the potential to have up to six seatmate behavior scores: (1) seatmates’ average aggression, (2) seatmates’ average prosocial, (3) popular seatmates’ aggression, (4) popular seatmates’ prosocial, (5) unpopular seatmates’ aggression, and (6)
unpopular seatmates’ prosocial. However, not all target children had both a popular and unpopular seatmate.

**Control variables.** Children’s ethnicity and gender were obtained from school records. Class size was computed from class rosters. Children with a larger pool of classmates to nominate for aggressive and prosocial behavior might not actually name as many more students as would be expected based on the increase in class size. As a result, larger classrooms might have smaller proportion scores for behavior, while having similar levels of actual behavior.

**Results**

**Data Preparation**

**Data transformations.** Variables were first examined for normal distributions. At both T1 and T2, aggression scores were positively skewed. These variables were square-root transformed. Classroom-level aggressive and prosocial behavior scores were calculated as the average of the relevant scores across all students in the classroom at T1.

**Centering and dummy coding.** For inclusion as fixed effects, target children’s aggressive and prosocial behavior scores were centered at the grand mean, as were classroom averages of the behaviors. Including both child- and classroom-level predictors in the models allowed the between-classroom variance in the behavior (i.e., classroom context) to be isolated from the within-classroom variation in children’s behavior. Class size was also centered at the grand mean. Target children’s popularity was centered at the classroom mean so that its effect represented only within-classroom variation in children’s popularity. Gender was coded as 0 for boys and 1 for girls. Ethnicity was dummy-coded with white as the reference group. Grade was centered at 3rd grade. Seating arrangements were coded as 0 for rows and 1 for groups.

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1 For cross-level interactions in Aim 1, the target child’s T1 behavior was centered at the classroom mean.
Seatmate behavior scores were centered within classroom, which eliminated between-classroom variance in aggression. This step was especially important for analyses of influence from popular (or unpopular) seatmates, as it isolated the effect of seatmate from the effect of classroom behavioral norms. That is, in a classroom with norms supporting aggression (i.e., aggression is correlated with popularity), popular seatmates’ average aggression scores would be greater than 0 prior to centering within classroom.

For inclusion as random slopes, target children’s behavior scores as well as seatmate behavior scores were centered at the classroom mean.

**Overview of modeling.** All models were estimated using multilevel models in SAS Proc Mixed to account for the nesting of children within classrooms. Restricted maximum likelihood (REML) estimation was used in all models. All models included a random intercept for classroom membership. Inclusion of random slopes for child-level variables differed across models, as described below.

**Preliminary Analyses**

Descriptive statistics for child-level variables are presented in Table 1. Peer nominations for aggression were lower than peer nominations for prosocial behavior at both T1 and T2, though the range for each behavior was wide. Partial correlations between child-level variables are presented in the top half of Table 2. Correlations controlled for classroom levels of aggressive and prosocial behavior to reveal within-classroom seating strategies. There was strong rank-order stability in both aggressive and prosocial behavior from T1 to T2. Girls were more prosocial and less aggressive than boys. Correlations revealed that seating placement appeared to be nonrandom: Compared to children with low aggression, highly aggressive children were less likely to have aggressive seatmates and more likely to have prosocial seatmates. Prosocial
children, in contrast, were more likely to have aggressive seatmates and less likely to have other prosocial seatmates.

Zero-order correlations between classroom-level variables are presented in the bottom half of Table 2. Compared to classrooms arranged as rows, group arrangements had lower levels of prosocial behavior at both T1 and T2, though the correlation was only marginally significant at T1 ($p < .10$). Classroom arrangement was not associated with levels of aggressive behavior. Finally, lower grades had higher prosocial behavior scores than did upper grades, but similar levels of aggression.

**Aim 1: Physical Arrangement of Seats Predicting Change in Behavior**

**Modeling strategy.** To address the first aim, analyses examined the association between the seating arrangement used in the classroom and changes in children’s aggressive and prosocial behavior from T1 to T2, a period of approximately two months. The majority of classrooms were in groups (N = 47; 67%), with the remaining 23 classrooms in rows.

Modeling for each behavior (i.e., aggressive and prosocial behavior) proceeded in three steps. In Model 1a, behavior at T2 was modeled as a function of the target child’s gender, ethnicity, and T1 behavior; as well as their class size, grade level, classroom-level T1 behavior, seating arrangement (rows vs. groups), and an interaction between seating arrangement and grade.

Model 1a was then compared to Model 1b, which was identical to Model 1a but included a random slope for the target child’s T1 behavior. The appropriate random structure of the model was determined by comparing models using log-likelihood ratio tests (LRTs). A random slope that was significant at $p < .05$ was then included in Model 1c, which also included a cross-level interaction between target children’s T1 behavior and the classroom seating arrangement.
**Results.** Results from the final models predicting changes in aggressive and prosocial behavior are presented in Table 3. There were no gender differences in changes in aggression, but girls’ prosocial scores were higher than boys’. Ethnicity was associated with both behaviors at T2. Compared to white children, African American children were more aggressive and less prosocial. There were no differences between Hispanic and white children. Children of other ethnicity were more prosocial than white children. There was strong continuity both in aggressive and prosocial behavior, as indicated by the significant coefficients for each behavior at T1 on its respective behavior at T2.

Class size and grade level did not predict behavior change. Classroom-level aggression was not a significant predictor of T2 aggression. Classroom average of prosocial behavior, however, was negatively associated with prosocial behavior at T2. Given the strong stability in target children’s prosocial behavior ($b = 0.81$), the remaining variance in prosocial behavior accounted for by the classroom level may simply represent extreme scores regressing to the mean.

The aggression and prosocial models differed in the effects of seating arrangement. There was a significant interaction between the target child’s T1 aggression and seating arrangement. As seen in Figure 2, group arrangements were associated with greater aggression, but only for children who were initially aggressive. Groups and rows did not differ significantly in their prosocial behavior.

**Aim 2: Seatmate Behavior as a Predictor of Changes in Children’s Behavior**

**Analytic strategy.** The next set of analyses examined the effect of seatmate behavior on changes in target children’s aggressive and prosocial behaviors. Because the results of Aim 1 suggested that trajectories of aggression differed in groups and rows, aggression models were
estimated separately for these two arrangements. Prosocial models were estimated on all classrooms, controlling for the effect of row versus group arrangement.

The different models analyzed for Aim 2 are summarized in Table 4. For each behavior and for each analytic sample, three models were analyzed. The first model (e.g., Model 1 in Table 3), was estimated using the average behavior across all seatmates. The second and third models (e.g., Models 2 and 3) used the average behaviors of only popular and unpopular seatmates, respectively. Separate models were run for the influence from popular seatmates and unpopular seatmates because not all children had both kinds of seatmates; including the effects from both popular and unpopular seatmates in the same model would have more severely reduced the analytic sample.

A series of modeling steps was used to arrive at the final version of each model. First, the target child’s behavior at T2 was modeled as a function of the target child’s gender, ethnicity, T1 behavior, and T1 popularity; and their seatmates’ behavior, classroom-level T1 behavior, grade, and class size. Three interactions were included at the child level (Level 1) to test whether the effect of seatmate behavior was moderated by the target child’s T1 behavior, gender, and popularity.

Next, a series of LRTs was used to determine whether random effects should be included for target child’s T1 behavior and seatmate behavior. Once the random structure of the model was determined, two cross-level interactions were added to test whether the effect of seatmates’ behavior depended on classroom-level behavior and grade level (e.g., Model 2d).

**Excluding classrooms.** Classrooms were excluded when there were fewer than four participating children with the specific type of seatmate (i.e., popular or unpopular). As a result,
one classroom was dropped from analyses of popular seatmates, and six classrooms were dropped from analyses of unpopular seatmates.

**Results:** Seatmate aggression as a predictor of changes in the target child’s aggression. Results from group arrangements are presented in Table 5. Results from row arrangements are presented in Table 6. The effects of control variables are best interpreted from the models examining the influence from all seatmates (i.e., Models 1 and 4), as the samples include all target children. In both rows and groups, target children’s aggression at T1 was a strong predictor of their aggression at T2. After controlling for baseline behaviors, target children’s gender, popularity and grade level were unrelated to aggression at T2. Class size was unrelated to aggression. The effect of seatmate aggression on target child’s aggression varied across classrooms arranged as groups and rows, as described below.

**Seatmate effects on target child’s aggression in group arrangements.** Model 1 revealed that there was a significant interaction between the effects of the target child’s initial level of aggression and seatmate aggression (see Figure 3a). For children who had low aggression scores at T1, having highly-aggressive seatmates was associated with greater aggression at T2. In contrast, for children who had high aggression scores at T1, there was no effect of seatmate aggression. The effect of seatmate behavior was not moderated by target child gender, popularity, classroom-level aggression, or grade level. The same effect of seatmate behavior was present when only popular seatmates were examined considered (Model 2), but not when only unpopular seatmates were considered (Model 3). Figure 3b shows the effect of popular seatmates from Model 2. Similar to Model 1, less-aggressive children had greater aggression when they had aggressive popular seatmates. In addition, highly-aggressive children were less aggressive when they sat with highly-aggressive seatmates.
Finally, two additional moderation tests reached marginal level levels of significance ($p < .10$). In Model 1, the effect of seatmate aggression was slightly greater in classrooms that had high levels of aggression. In Model 2, the effect of popular seatmates’ aggression was slightly greater in upper grades.

**Seatmate effects on target child’s aggression in row arrangements.** Model 4 revealed a marginally significant interaction between all seatmates’ aggression and the target child’s popularity at T1. Models 5 and 6 revealed that this interaction effect reached traditional levels of significance when the behavior popular seatmates were considered ($p < .05$). The effect was not significant when only the behavior of unpopular seatmates was considered. The interaction between popular seatmates’ behavior and the target child’s popularity at T1 is presented in Figure 4. For popular children, sitting with popular children who were highly aggressive was actually associated with less aggression. For unpopular children, the opposite was true: Sitting with popular, aggressive children was associated with increased aggression.

**Results: Seatmate prosocial behavior as a predictor of changes in the target child’s prosocial behavior.** Results from the models predicting prosocial behavior are presented in Table 7. The target child’s prosocial behavior at T1 was a strong predictor of their prosocial behavior at T2. After controlling for baseline behavior, girls were more prosocial than boys, and popularity was positively related to prosocial behavior. Classrooms that had more prosocial behavior, on average, at T1 had showed less prosocial behavior at T2. Grade level was unrelated to prosocial behavior, and larger class sizes had marginally lower prosocial behavior ($p < .10$).

Finally, there was a strong interaction between seatmate prosocial behavior and target child’s popularity (Figure 5). Unpopular children were more prosocial when they had highly prosocial seatmates, compared to when they had less-prosocial seatmates; in contrast, popular
children’s behavior was unrelated to their seatmates’ prosocial behavior. Models 8 and 9 explored the role of popular and unpopular seatmates’ prosocial behavior, respectively, in the prediction of the focal child’s prosocial behavior. Both models found this interaction effect between the target child’s popularity and seatmates’ prosocial behavior.

Discussion

In a recent review of peer influence research, Brechwald and Prinstein (2011) noted that the past decade has brought an increased focus on different sources of peer influence, including friendships, peer groups, and romantic relationships. The present study contributes to this body of work by examining seatmates as a source of peer influence on aggression and prosocial behavior. The goal of this study was to examine changes in children’s behavior as a function of the physical arrangement of seats, as well as the aggressive and prosocial behaviors of children’s seatmates. Results suggest that seatmates may influence behavior, but the pattern of effects varied across models. Below, several possible explanations for the results are discussed. Furthermore, as research on seatmate effects is relatively new, research strategies are presented that may help future studies avoid some of the challenges encountered in the present study.

Groups versus Rows: Classroom Arrangements and Children’s Behavior

The first aim was to understand how different seating arrangements were associated with changes in children’s behavior across a period of several months. It was expected that classrooms arranged as groups would have more aggressive behavior and less prosocial behavior at the two-month follow-up, compared to classrooms arranged as rows. Simple correlations showed that aggressive behavior did not differ systematically across group and row arrangements; however, prosocial behavior was lower in groups at both T1 and T2. When baseline levels of behavior were accounted for, children who were initially aggressive showed
greater aggression when they were in groups compared to rows. Classroom arrangement did not predict children’s changes in prosocial behavior.

These findings are in line with a small body of work showing that children have more disruptive and off-task behavior when they are arranged in groups rather than rows (Wannarka & Ruhl, 2008). One possible explanation for the consistent finding that group arrangements have generally negative effects is that such arrangements are not being used for the tasks for which they are best suited. Research shows that group work, which requires collaboration among students, is well-suited to group arrangements (Wheldall & Bradd, 2010; Kern & Clemens, 2000; Wannarka & Ruhl, 2008); however, children in groups are typically expected to do individual seatwork (Hastings, 1995; Wheldall & Bradd, 2010). A lack of well-organized groupwork activities, coupled with constant opportunities for peer interaction, seem to set the stage for less prosocial behavior.

In the place of prosocial interactions, aggressive interactions appeared to flourish in group arrangements. Research shows that aggressive children are especially likely to interpret peers’ ambiguous interactions as hostile, which could explain why, in groups, children who were initially aggressive were most negatively affected (de Castro, Veernman, Koops, Bosch, & Monshouwer, 2002). Group arrangements likely allow for greater peer reinforcement for aggressive behavior as well. Axelrod and colleagues (1979) suggested that group arrangements had more off-task behavior because children can easily catch one another’s attention. In groups, children only need to look at a seatmate or kick a seatmate under the desk or table to get his or her attention; in rows, these tactics are difficult and would quickly draw the teacher’s attention. Similarly, it might be easier for a child to get his or her classmates to react to aggressive behaviors with laughs or smiles in group arrangements.
An alternative explanation is that a selection process biased results. There may be important differences in the behavior management strategies of teachers who use groups and teachers who use rows to arrange their students, and these differences could also be associated with students’ behavioral outcomes. Teachers who use groups likely value system interactions among students. Teachers who choose groups might, for instance, prefer group learning strategies and tolerate more noise and activity in their classrooms, compared to teachers who choose rows. Thus, the behavioral differences between groups and rows could be tied not to the seating arrangement in particular, but to the overall management of the classroom.

**Seatmate Behavior and Changes in Children’s Aggressive and Prosocial Behavior**

Whereas several small studies have examined classroom behavior for groups versus rows, almost no work has considered seatmate influences on behavior. Therefore, results from the present study are preliminary and must be replicated before recommendations can be made for the best seating arrangements.

Zero-order correlation analyses showed that seating was not random: Aggressive children were unlikely to be sitting with other aggressive peers, and likely to be sitting with more prosocial peers. Teachers seemed to be separating aggressive children and providing aggressive children with prosocial seatmates. This strategy falls in line with recommendations for classroom management from peer researchers, who advise teachers to separate potentially disruptive children as well as to combine certain children to promote beneficial friendships (Pearl et al., 2007). To better understand the potential effectiveness of such strategies, seatmate behavior was examined as a predictor of change in target children’s aggressive and prosocial behavior.

Correlations revealed that both aggressive and prosocial behavior scores had very high rank-order stability ($r = .77$ and $.71$, respectively). To determine whether the behavior of a child’s
seatmates accounted for a portion of the remaining variance, multilevel modeling was used to estimate the effect of seatmates’ behavior at baseline on changes in children’s behavior across approximately two months. Our hypotheses were partially supported, as described below.

**Seatmate aggression and changes in target children’s aggression.** First, changes in children’s aggressive behavior were examined as a function of the aggressive behavior of their seatmates. In group arrangements, only children who were initially low in aggression appeared to adopt the aggressive behavior pattern of their seatmates. Further analyses revealed that target children seem to be influenced by seatmates who were popular, but not seatmate who were unpopular. Contrary to expectations, aggressive children had slightly less aggression when they had aggressive, popular seatmates, compared to aggressive children with low-aggression, popular seatmates.

When a popular child is aggressive, it communicates to others that aggression is rewarded with social power (Dijkstra, Lindenberg, & Veenstra, 2008). Results suggest that using well-behaved children as positive role models for aggressive children in the seating arrangement could have negative consequences for the role model, especially when the aggressive children are also popular. Results are contrary to the those of Hektner, August, and Realmuto (2003), who found that using a well-behaved child as a positive peer model for an aggressive child had no negative effect on the peer model. One possible reason for the different effects in the present study is that Hektner and colleagues only placed children together for specific activities, whereas seatmates are together for many hours per day—whenever they are supposed to be in their seats. Still, non-aggressive children remained low in aggression, so the negative effect on peer models is likely small.
The surprising finding that aggressive children were more aggressive when they had less-aggressive seatmates serves as a reminder of the difficulty in changing children’s problematic behavior. Aggressive children may have elicited aggressive responses or some other form of attention from their less-aggressive seatmates, and these responses probably helped maintain aggressive children’s patterns of behavior (Peplar et al., 1998). Another possibility is that changing behavior requires specific conditions that foster children’s peer affiliations as well as opportunities for social learning. Decades ago, Gronlund (1959) suggested that teachers could manage children’s behavior, at least in part, by shaping children’s relationships. He advised teachers to dissolve aggressive cliques not by placing aggressive children with the best-behaved children in the classroom, but by placing aggressive children with peers whom they liked and who were slightly better-behaved. The goal was to create an arrangement that increased the likelihood that an aggressive child would befriend a slightly less-aggressive child and, as a result, adopt a pattern of better behavior.

Indeed, children are more likely to befriend children who are similar in behavior to themselves (Cairns & Cairns, 1994), and tend to model children who are similar and whom they like (Bandura, 1986). In short, placing aggressive children with seatmates who are only slightly less aggressive may create beneficial friendships, as well as provide aggressive children with peers they are likely to imitate. In contrast, placing aggressive children with “perfect” children may do nothing to change aggressive children’s affiliations and behavior. Gest and Rodkin (2013) recently found that children who sat next to each other were more likely to become friends, suggesting that friendship formation may indeed be an important component of seatmate influence.
A selection process might also explain the surprising result that children who were initially aggressive fared best when they were with other aggressive children. It is possible that aggressive children who were placed with other aggressive seatmates did not pose as much of a behavioral concern to the teacher, compared to aggressive children who were placed with very well-behaved children. These latter children could have pervasive and disregulated behavior problems that would have continued to pose a threat regardless of seating placement. This process can be conceptualized as the opposite problem that exists in friendship research: Whereas selection effects bias friendship research to overestimate the amount of similarity due to peer influence (Kinderman & Gest, 2009), naturalistic studies of seatmates research may underestimate the amount of similarity that is due to seatmate influence.

Stepping away from group arrangements, results from the row arrangement were slightly more in line with our expectations. Popular seatmates’ aggression was associated with increases in the target child’s aggression, but only when the target child was unpopular. Previous research has shown that unpopular children are more influenced by their peers’ behaviors (Shi & Xie, 2012). For popular children, however, sitting with popular aggressive children was associated with less aggression. These results paint a complicated picture of popularity and aggression in the seating arrangement. It is possible that these results are also biased by a similar selection process as that described above. For example, teachers could put more thought into the placement of a popular child in the classroom because they are so salient. A popular child whom the teacher believes would benefit from having well-behaved seatmates might end up with greater behavior problems than a popular child whom the teacher believes would be fine with aggressive seatmates, resulting in lower aggression among the popular children sitting with aggressive seatmates.
The role of seatmates in aggression varied between groups and rows. One possible explanation is that friendship formation is a more important mediator of the effects in group arrangements, as children have more face-to-face contact and social interaction. In fact, seatmates are more likely to become friends when they are seated in groups rather than rows (Gest & Rodkin, 2013).

**Seatmate prosocial behavior and changes in target children’s prosocial behavior.**
The prosocial behavior of a child’s seatmates also appeared to play a role in the behavior change of at least some children. As expected, unpopular children showed the greatest benefit from sitting with prosocial seatmates. In contrast, the prosocial behavior of target children who were popular was consistently high, regardless of their seatmates’ behavior. The clear benefit of having prosocial seatmates for unpopular children suggests, again, that unpopular children are more open to influence from their seatmates. Interestingly, the benefit to unpopular children remained in models considering only the effects of popular and unpopular seatmates, separately. These findings suggest that prosocial behavior is universally valued, whereas the appeal of adopting aggressive behavior depends on the social status awarded to aggressive peers (Dijkstra, Lindenberg, & Veenstra, 2008). Indeed, prosocial behaviors are generally associated with greater likeability by a child’s peers (Coie, Dodge, & Kupersmidt, 1990).

**Variation in seatmate effects across gender and grade.** Across all nine models, there was very little evidence for variation in seatmate effects by target children’s gender or grade. Still, the target child’s gender may an important moderator when seatmates’ gender is also taken into consideration. For example, girls may be influenced by female seatmates, but not male seatmates. Although it was hypothesized that children in upper grades would be more influenced by their seatmates because they spend more time in their seats, this was not the case. One
possible explanation is that the increasing importance of peer groups and their influence during middle childhood (Brechwald & Prinstein, 2011) cancels out the effect of additional time spent with seatmates. Future studies should consider whether seatmates are more important as children age. Compared to the small studies that have examined seating arrangements in the past (see Wannarka & Ruhl, 2008), the sample of 70 classrooms used in the present study is a great improvement in sample size; however, results may not be generalizable across other populations of classrooms.

Limitations and Future Directions

The present study is the first to consider the potential for seating arrangements and seatmates to influence children’s aggressive and prosocial behavior, so it is no surprise that results were somewhat ambiguous. One of the greatest benefits of the present study is the insight it has provided, allowing us to make several recommendations for future research in this very important domain. The limitations of the present study are situated within a discussion of directions for future research. Opportunities for research are described across three types of studies: large-scale naturalistic studies, such as the present study; small, intensive observational studies; and studies with an experimental design.

Large-scale naturalistic studies. One common approach to studying peer relations is to assess a large number of classrooms at two or more points within a school year, typically through surveys, but also through observations. Having analyzed data from one such study, we have several recommendations that can increase the potential of future studies to inform research on seatmate influence. First, perhaps the greatest challenge in analyzing seating chart data is that children typically have multiple seatmates. The present study used an average of the behavior across seatmates so that results could be situated within existing research on peer group
influence. However, whereas children in peer groups tend to behave similarly (Cairns & Cairns, 1994), correlations in the present study suggest that teachers are placing very different children together. Averaging across seatmates may not necessarily be the ideal approach to quantifying seatmates’ influence.

One alternative approach is for researchers to focus on classrooms in which the absence of confounding variables occurs naturally. For example, studies can focus on classrooms in which children are grouped in desk sets of two, so that each child has just one seatmate. Additionally, findings from the present study suggests that children may be especially influenced by popular seatmates, at least for aggressive behavior. It could be useful to examine only children who had a single popular seatmate (and an unlimited number of unpopular seatmates). Such strategies would also allow researchers to avoid averaging across boy and girl seatmates, as was necessary in the present study. Future studies using single-seatmate scenarios could examine whether the influence of a seatmate depends on the gender configuration of the target child and seatmate. Of course, most classrooms will not have this two-desk arrangement. In such cases, other indices of seatmate behavior can be examined, such as the maximum aggression score of a seatmates or the homogeneity in seatmates’ behaviors using a variance statistic.

Another limitation in the present study is that it was not clear how long children remained in the seating arrangement provided by the teacher—seating arrangements may have lasted for a few days or for the entire time between assessments. For the purpose of this paper, it was assumed that children spent a significant length of time with their T1 seatmates. Future naturalistic studies should attempt to document all seating changes, which would allow researchers to examine whether more stable seating arrangements showed stronger seatmate
effects. Findings will inform experimental research by suggesting a length of time necessary for change to occur through seating arrangement manipulation (van den Berg et al., 2013).

Although we speculated that seatmates might influence children’s behavior as a result of positive ties between seatmates, no mediation processes were tested. Future studies should collect data on peer liking and friendships across time and test this mediation model. Preliminary analyses from the present study indicate seating proximity does increase the friendships and liking among children (Gest & Rodkin, 2013; van den Berg et al., 2013).

**Small, intensive observational studies.** Whereas large studies will provide the statistical power needed to detect small but stable changes in children’s behavior, smaller observational studies will be necessary to clarify the mechanisms underlying seatmate influence and identify the behaviors most likely to be influenced (van den Berg et al., 2013). For example, we hypothesized that the processes of provocation, reinforcement, and modeling are responsible for seatmate influence, but the study design did not allow for the identification of these processes. Intensive observational studies could use count-based measures of interactions between a child and his or her seatmates to determine whether these processes take place, and which are more likely to result in behavior change.

The peer-nomination measures used in the present study were designed for stability, and previous work has found these indices to have strong test-retest reliability across three weeks (Farmer, Estell, Bishop, O’Neal, & Cairns, 2003). Observational measures could capture changes in a child’s behavior that would not be detectable using teacher or peer reports, which may be biased by the child’s reputation (Bierman, Miller, & Stabb, 1987). Observational measures of behavior would also reveal the time and place of the behaviors. For example, a target child’s
behavior might be reinforced in the seating arrangement, but measurable changes in aggressive behaviors might not be visible until recess.

Observational studies would also allow researchers to explore the moderating effect of adjacent children’s physical position (i.e., side-by-side, face-to-face, and diagonal). In the present study, all seatmates were given equal weight in their potential to influence the target child, but observational study may reveal that face-to-face arrangements, for example, provide more opportunities for influence than do side-by-side arrangements. A starting point would be to determine the typical rates of interaction between children in these different positions during different kinds of activities.

**Experimental studies.** Experiments are the gold standard for identifying causal relationships among variables (Shadish, Cook, & Campbell, 2002). As previously mentioned, selection effects such as teachers’ value systems and strategies for arranging disruptive children likely bias naturalistic studies of seatmate influence. In an experimental design, classrooms could be compared across two or more different conditions. For example, in a simple design to test whether seatmates influence aggressive behavior, a control condition would have children randomly assigned to their seats. One experimental condition would pair an aggressive child with a child who was low in aggression, and another experimental condition would pair each aggressive child with another aggressive child. All other conditions would be the same (e.g., seating arrangement as groups or rows; use of cooperative learning strategies). Of course, a major challenge in applying experimental designs will be convincing teachers to release control over their seating arrangements. It is possible, though: van den Berg and colleagues (2013) successfully implemented an intervention in upper-elementary grade classrooms in which researchers moved children who disliked one another closer together. Future iterations of
experimental designs could vary the popularity, gender, and other variables of target children and seatmates.

**Additional limitations.** Finally, a note regarding methodological limitations is in order. First, analysis variables were not independent: Children were both target children and seatmates; moreover, a child could be a seatmate to more than one target child. Future work could avoid this problem by randomly selecting one child from each group or row, and considering the effect of his or her seatmates’ behavior. Second, results suggest that the effect of seatmates’ behavior may not be linear. For highly aggressive children, sitting next to a “perfect,” well-behaved child may result in no changes—or even increases—in aggression. Future analyses could examine whether the greatest benefit for aggressive children is having seatmates who are moderately aggressive. Finally, if children switched seats before T2, the effect of a seatmate could have faded out by the time children’s behavior change was assessed. It would be useful to examine the association between a target child’s behavior and his or her *current* seatmates, controlling for behavior at a previous time point. Such an analysis might reveal even stronger effects of seatmates.

**Implications**

As research on seatmate influence is in its early stages, it is impossible to draw sweeping conclusions from the present study. Nonetheless, when results are considered alongside the existing body of work finding more disruptive behavior in groups compared to rows, the potential benefit to using rows for behavior management becomes especially clear (Wannarka & Ruhl, 2008; Wheldall & Bradd, 2010). As others have recommended, teachers might consider switching to group arrangements only when group collaboration is desired (Wannarka & Ruhl, 2008; Wheldall & Bradd, 2010).
A second implication is that the popularity of the seatmates and target children should not be overlooked when behavior change is desired. Popularity is a powerful motivator of behavioral change, but further study is needed to understand how popular seatmates might be strategically utilized to improve behavior in the classroom. Finally, teachers should not assume that pairing a well-behaved child with an aggressive child will benefit the aggressive child and leave the well-behaved child unaffected. Results suggest that well-behaved children might actually develop behavior problems after sitting with aggressive children. At the same time, conflicting evidence from the prosocial models suggests that prosocial seatmates could benefit unpopular children. In short, the findings from the present study suggest that studying seatmate influence is not a simple area; however, given the ease with which teachers could implement recommended seating strategies as a means to manage classrooms (van den Berg et al., 2013), future research on seating arrangements has the potential to be very useful.
References


Gest, S. D., & Rodkin, P. (2013). Teacher effects on classroom peer relationships: Seating charts


Kindermann, T., & Gest, S. D. (2009). Assessment of the peer group: Identifying naturally
occurring social networks and capturing their effects. In K. Rubin, W. Bukowski, & B. Laursen (Eds.), *Handbook of peer interactions, relationships and groups* (pp. 100-118). New York: Guilford.


Table 1
Descriptive Statistics for Child-Level Variables (N = 1164)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 Aggression&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.26</td>
<td>0.21</td>
<td>0</td>
<td>0.92</td>
</tr>
<tr>
<td>T2 Aggression&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.27</td>
<td>0.23</td>
<td>0</td>
<td>0.96</td>
</tr>
<tr>
<td>T1 Prosocial Behavior</td>
<td>0.40</td>
<td>0.21</td>
<td>0</td>
<td>0.97</td>
</tr>
<tr>
<td>T2 Prosocial Behavior</td>
<td>0.40</td>
<td>0.20</td>
<td>0</td>
<td>0.94</td>
</tr>
<tr>
<td>T1 Popularity</td>
<td>0.05</td>
<td>0.33</td>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>Number of seatmates</td>
<td>2.48</td>
<td>1.09</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

Note. T1 = Time 1, T2 = Time 2. <sup>a</sup> Square-root transformed.
Table 2  
*Correlations Among Child- and Classroom-Level Variables*

<table>
<thead>
<tr>
<th>Partial correlations among child-level measures</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focal child variables</strong>&lt;sup&gt;a&lt;/sup&gt; (&lt;i&gt;N = 1164&lt;/i&gt;)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Girl</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. T1 Popularity</td>
<td>0.11***</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. T1 Aggression&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-0.26***</td>
<td>-0.13***</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. T2 Aggression&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-0.19***</td>
<td>-0.06**</td>
<td>0.71***</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. T1 Prosocial Behavior</td>
<td>0.29***</td>
<td>0.41***</td>
<td>-0.66***</td>
<td>-0.56***</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>6. T2 Prosocial Behavior</td>
<td>0.30***</td>
<td>0.39***</td>
<td>-0.60***</td>
<td>-0.58***</td>
<td>0.79***</td>
<td>--</td>
</tr>
<tr>
<td>**Seatmate (SM) variables at T1&lt;sup&gt;a&lt;/sup&gt; (&lt;i&gt;N = 796–1164&lt;/i&gt;)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Aggression&lt;sup&gt;b&lt;/sup&gt;: All SM</td>
<td>0.07*</td>
<td>-0.01</td>
<td>-0.18***</td>
<td>-0.15**</td>
<td>0.12***</td>
<td>0.11***</td>
</tr>
<tr>
<td>8. Prosocial behavior: All SM</td>
<td>-0.10***</td>
<td>-0.02</td>
<td>0.10***</td>
<td>0.11*</td>
<td>-0.10***</td>
<td>-0.08**</td>
</tr>
<tr>
<td>9. Aggression&lt;sup&gt;b&lt;/sup&gt;: Popular SM</td>
<td>0.05</td>
<td>-0.11***</td>
<td>-0.15**</td>
<td>-0.14***</td>
<td>0.08**</td>
<td>0.09**</td>
</tr>
<tr>
<td>10. Prosocial: Popular SM</td>
<td>-0.07*</td>
<td>0.04</td>
<td>0.09**</td>
<td>0.14**</td>
<td>-0.06*</td>
<td>-0.06</td>
</tr>
<tr>
<td>11. Aggression&lt;sup&gt;b&lt;/sup&gt;: Unpop. SM</td>
<td>0.06</td>
<td>0.05</td>
<td>0.10**</td>
<td>-0.09**</td>
<td>0.08*</td>
<td>0.03</td>
</tr>
<tr>
<td>12. Prosocial: Unpop. SM</td>
<td>-0.09*</td>
<td>-0.08</td>
<td>0.07*</td>
<td>0.06*</td>
<td>-0.08*</td>
<td>-0.04</td>
</tr>
<tr>
<td>**Zero-order correlations among classroom-level measures variables (&lt;i&gt;N = 70&lt;/i&gt;)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. T1 Aggression&lt;sup&gt;b&lt;/sup&gt;</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. T2 Aggression&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.69***</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. T1 Prosocial Behavior</td>
<td>0.01</td>
<td>-0.04</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. T2 Prosocial Behavior</td>
<td>-0.37**</td>
<td>-0.37**</td>
<td>0.72***</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Group Arrangement (vs. Rows)</td>
<td>-0.003</td>
<td>0.11</td>
<td>-0.20+</td>
<td>-0.28*</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>6. Grade</td>
<td>0.16</td>
<td>0.16</td>
<td>0.50***</td>
<td>0.34**</td>
<td>-0.05</td>
<td>--</td>
</tr>
<tr>
<td>7. Class size</td>
<td>0.20</td>
<td>0.06</td>
<td>-0.32**</td>
<td>-0.39***</td>
<td>0.15</td>
<td>0.15</td>
</tr>
</tbody>
</table>

<sup>a</sup>P < .05, **p < .01, ***p < .001.

<sup>b</sup>Note. T1 = Time 1; T2 = Time 2.

<sup>a</sup>Partial correlations control for classroom average aggressive and prosocial behavior.

<sup>b</sup>Square-root transformed.
Table 3
Predicting Target Children’s Behavior at T2 from Seating Arrangement (N = 1164 children, 70 classrooms)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Aggressive Behavior</th>
<th>Prosocial Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b</td>
<td>SE</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.255***</td>
<td>(0.019)</td>
</tr>
<tr>
<td><strong>Level 1: Child</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target Child’s Gender: Girl</td>
<td>-0.008</td>
<td>(0.008)</td>
</tr>
<tr>
<td>Target Child’s Ethnicity (Reference = white)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>0.033**</td>
<td>(0.011)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>-0.022</td>
<td>(0.016)</td>
</tr>
<tr>
<td>Other</td>
<td>-0.029</td>
<td>(0.015)</td>
</tr>
<tr>
<td>Target Child's T1 Behavior</td>
<td>0.660***</td>
<td>(0.059)</td>
</tr>
<tr>
<td><strong>Level 2: Classroom</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class Size</td>
<td>-0.004</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Grade</td>
<td>0.010</td>
<td>(0.011)</td>
</tr>
<tr>
<td>Classroom Average of T1 Behavior</td>
<td>0.163</td>
<td>(0.124)</td>
</tr>
<tr>
<td>Seating Arrangement: Groups (Reference = Rows)</td>
<td>0.030</td>
<td>(0.022)</td>
</tr>
<tr>
<td><strong>Cross-Level Interactions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seating Arrangement X Grade</td>
<td>-0.008</td>
<td>(0.013)</td>
</tr>
<tr>
<td>Seating Arrangement X Target Child's T1 Behavior</td>
<td>0.148*</td>
<td>(0.070)</td>
</tr>
<tr>
<td><strong>Residual variance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.006***</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Target Child's T1 Behavior</td>
<td>0.041***</td>
<td>(0.012)</td>
</tr>
</tbody>
</table>

+p < .10, *p < .05, **p < .01, ***p < .001.
Table 4
Summary of modeling Steps for Aim 2: Predicting Target Children’s Behavior from Seatmate Behavior.

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Classrooms Analyzed</th>
<th>Seatmates Analyzed</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group Arrangements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggression</td>
<td>All</td>
<td>Popular</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unpopular</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Row Arrangements</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>Popular</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unpopular</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>All</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Popular</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unpopular</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All</td>
<td>7</td>
</tr>
<tr>
<td>Prosocial</td>
<td>All</td>
<td>Popular</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unpopular</td>
<td>9</td>
</tr>
</tbody>
</table>
Table 5  
*Classrooms Arranged as Groups: Multilevel Models Predicting Target Child’s Aggression from Seatmate Aggression*

<table>
<thead>
<tr>
<th></th>
<th>Model 1 All Seatmates (N=829 children in 47 classrooms)</th>
<th>Model 2 Popular Seatmates (N=683 children in 47 classrooms)</th>
<th>Model 3 Unpopular Seatmates (N=642 children in 45 classrooms)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b</td>
<td>SE</td>
<td>b</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.275***</td>
<td>(0.014)</td>
<td>0.276***</td>
</tr>
<tr>
<td><strong>Level 1: Child</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target Child’s Gender: Girl</td>
<td>0.004 (0.010)</td>
<td>-0.005 (0.011)</td>
<td>0.014 (0.011)</td>
</tr>
<tr>
<td>Target Child’s T1 Aggression</td>
<td>0.814*** (0.035)</td>
<td>0.827*** (0.029)</td>
<td>0.815*** (0.043)</td>
</tr>
<tr>
<td>Target Child’s T1 Popularity</td>
<td>0.016 (0.015)</td>
<td>0.013 (0.017)</td>
<td>0.022 (0.017)</td>
</tr>
<tr>
<td>Seatmate Aggression</td>
<td>0.041 (0.062)</td>
<td>-0.004 (0.065)</td>
<td>0.017 (0.052)</td>
</tr>
<tr>
<td><strong>Level 2: Classroom</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classroom Average of T1 Aggression</td>
<td>-0.129 (0.142)</td>
<td>-0.181 (0.145)</td>
<td>-0.097 (0.153)</td>
</tr>
<tr>
<td>Grade</td>
<td>0.004 (0.007)</td>
<td>0.003 (0.007)</td>
<td>0.004 (0.007)</td>
</tr>
<tr>
<td>Class Size</td>
<td>-0.008 (0.004)</td>
<td>-0.007 (0.004)</td>
<td>-0.009* (0.004)</td>
</tr>
<tr>
<td><strong>Level 1 Interactions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seatmate Aggression X T1 Aggression</td>
<td>-0.507* (0.248)</td>
<td>-0.578** (0.217)</td>
<td>-0.010 (0.207)</td>
</tr>
<tr>
<td>Seatmate Aggression X Girl</td>
<td>-0.140 (0.089)</td>
<td>-0.025 (0.095)</td>
<td>-0.105 (0.073)</td>
</tr>
<tr>
<td>Seatmate Aggression X T1 Popularity</td>
<td>-0.092 (0.120)</td>
<td>-0.090 (0.123)</td>
<td>-0.029 (0.113)</td>
</tr>
<tr>
<td><strong>Cross-Level Interactions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seatmate Aggression X Classroom-Level Aggression</td>
<td>1.059+ (0.553)</td>
<td>0.428 (0.547)</td>
<td>0.181 (0.539)</td>
</tr>
<tr>
<td>Seatmate Aggression X Grade</td>
<td>0.012 (0.025)</td>
<td>0.043+ (0.023)</td>
<td>-0.013 (0.020)</td>
</tr>
<tr>
<td><strong>Residual variance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.006***</td>
<td>(0.001)</td>
<td>0.006***</td>
</tr>
<tr>
<td>Target Child’s T1 Aggression</td>
<td>0.023* (0.012)</td>
<td></td>
<td>0.034* (0.018)</td>
</tr>
</tbody>
</table>

_p < .10, _*p < .05, **p < .01, ***p < .001._

_Note._ Models control for child ethnicity.
Table 6
Classrooms Arranged as Rows: Multilevel Models Predicting Target Child’s Aggression from Seatmate Aggression

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b</td>
<td>SE</td>
<td>b</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.278</td>
<td>(0.021)</td>
<td>0.277***</td>
</tr>
<tr>
<td><strong>Level 1: Child</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target Child’s Gender: Girl</td>
<td>-0.039*</td>
<td>(0.015)</td>
<td>-0.040*</td>
</tr>
<tr>
<td>Target Child’s T1 Aggression</td>
<td>0.634***</td>
<td>(0.071)</td>
<td>0.586***</td>
</tr>
<tr>
<td>Target Child’s T1 Popularity</td>
<td>0.001</td>
<td>(0.022)</td>
<td>-0.041</td>
</tr>
<tr>
<td>Seatmate Aggression</td>
<td>-0.011</td>
<td>(0.065)</td>
<td>0.024</td>
</tr>
<tr>
<td><strong>Level 2: Classroom</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classroom Average of T1 Aggression</td>
<td>0.378+</td>
<td>(0.194)</td>
<td>0.468*</td>
</tr>
<tr>
<td>Grade</td>
<td>-0.002</td>
<td>(0.011)</td>
<td>-0.002</td>
</tr>
<tr>
<td>Class Size</td>
<td>0.005</td>
<td>(0.006)</td>
<td>0.004</td>
</tr>
<tr>
<td><strong>Level 1 Interactions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seatmate Aggression X T1 Aggression</td>
<td>-0.085</td>
<td>(0.251)</td>
<td>-0.389</td>
</tr>
<tr>
<td>Seatmate Aggression X Girl</td>
<td>0.024</td>
<td>(0.093)</td>
<td>-0.110</td>
</tr>
<tr>
<td>Seatmate Aggression X T1 Popularity</td>
<td>-0.264+</td>
<td>(0.142)</td>
<td>-0.297*</td>
</tr>
<tr>
<td><strong>Cross-Level Interactions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seatmate Aggression X Classroom-Level Aggression</td>
<td>-0.528</td>
<td>(0.502)</td>
<td>-0.496</td>
</tr>
<tr>
<td>Seatmate Aggression X Grade</td>
<td>0.001</td>
<td>(0.029)</td>
<td>0.021</td>
</tr>
</tbody>
</table>

Residual variance

<table>
<thead>
<tr>
<th></th>
<th>b</th>
<th>SE</th>
<th>b</th>
<th>SE</th>
<th>b</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.004**</td>
<td>(0.002)</td>
<td>0.005*</td>
<td>(0.002)</td>
<td>0.003</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Target Child’s T1 Aggression</td>
<td>0.070*</td>
<td>(0.031)</td>
<td>0.099*</td>
<td>(0.045)</td>
<td>0.068+</td>
<td>(0.045)</td>
</tr>
</tbody>
</table>

*p < .10, *p < .05, **p < .01, ***p < .001.

Note. Models control for child ethnicity.
Table 7
*Multilevel Models Predicting Target Child’s Prosocial Behavior from Seatmates’ Average Prosocial Behavior*

<table>
<thead>
<tr>
<th></th>
<th>Model 7 All Seatmates (N=1164 children; 70 classrooms)</th>
<th>Model 8 Popular Seatmates (N=913 children in 69 classrooms)</th>
<th>Model 9 Unpopular Seatmates (N=796 children in 64 classrooms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.385*** (0.009)</td>
<td>0.386*** (0.010)</td>
<td>0.391*** (0.009)</td>
</tr>
<tr>
<td><strong>Level 1: Child</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target Child’s Gender: Girl</td>
<td>0.031*** (0.007)</td>
<td>0.033*** (0.007)</td>
<td>0.021** (0.008)</td>
</tr>
<tr>
<td>T1 Prosocial</td>
<td>0.755*** (0.020)</td>
<td>0.741*** (0.024)</td>
<td>0.745*** (0.024)</td>
</tr>
<tr>
<td>T1 Popularity</td>
<td>0.051*** (0.011)</td>
<td>0.055*** (0.013)</td>
<td>0.063*** (0.013)</td>
</tr>
<tr>
<td>Seatmate Prosocial Behavior</td>
<td>0.049 (0.037)</td>
<td>-0.021 (0.042)</td>
<td>0.110 (0.045)</td>
</tr>
<tr>
<td><strong>Level 2: Classroom</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seating Arrangement: Groups (Reference = Rows)</td>
<td>-0.030+ (0.017)</td>
<td>-0.027 (0.018)</td>
<td>-0.023 (0.017)</td>
</tr>
<tr>
<td>Classroom Average of T1 Prosocial Behavior</td>
<td>-0.208* (0.092)</td>
<td>-0.193+ (0.098)</td>
<td>-0.232* (0.089)</td>
</tr>
<tr>
<td>Grade</td>
<td>0.003 (0.006)</td>
<td>0.004 (0.006)</td>
<td>0.006 (0.005)</td>
</tr>
<tr>
<td>Class Size</td>
<td>-0.005+ (0.003)</td>
<td>-0.004 (0.003)</td>
<td>-0.003 (0.003)</td>
</tr>
<tr>
<td><strong>Level 1 Interactions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seatmate Prosocial Behavior X T1 Prosocial Behavior</td>
<td>0.130 (0.151)</td>
<td>0.129 (0.174)</td>
<td>0.170 (0.162)</td>
</tr>
<tr>
<td>Seatmate Prosocial Behavior X Girl</td>
<td>-0.054 (0.055)</td>
<td>0.039 (0.062)</td>
<td>-0.119 (0.066)</td>
</tr>
<tr>
<td>Seatmate Prosocial Behavior X T1 Popularity</td>
<td>-0.203*** (0.073)</td>
<td>-0.174* (0.087)</td>
<td>-0.196* (0.079)</td>
</tr>
<tr>
<td><strong>Cross-Level Interactions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seatmate Prosocial Behavior X Classroom-level T1 Prosocial Behavior</td>
<td>-0.476 (0.333)</td>
<td>-0.533 (0.377)</td>
<td>0.143 (0.405)</td>
</tr>
<tr>
<td>Seatmate Prosocial Behavior X Grade</td>
<td>0.005 (0.017)</td>
<td>0.012 (0.019)</td>
<td>-0.027 (0.021)</td>
</tr>
<tr>
<td>Residual variance</td>
<td>Est. SE</td>
<td>Est. SE</td>
<td>Est. SE</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.004*** (0.001)</td>
<td>0.004*** (0.001)</td>
<td>0.003*** (0.001)</td>
</tr>
</tbody>
</table>

+ p < .10, * p < .05, **p < .01, ***p < .001.

Note. Models control for child ethnicity.
Figure 1. Example of a seating chart obtained in Years 3 and 4 of the study. This seating chart is arranged in a row format. In this example, if Ann is the target child, her seatmates would be Lexi and Joan.
Figure 2. Estimation of target child’s aggression at Time 2 based on classroom seating arrangement and target child’s aggression at Time 1. Children who were highly aggressive at Time 1 showed greater aggression scores at Time 2 when they were in group arrangements compared to row arrangements. Arrangement was unrelated to behavior change in children who were less aggressive at Time 1.
Figure 3. Estimation of target child’s aggression at Time 2 based on seatmate aggression at Time 1 and target child’s aggression at Time 1 (groups). Figure 3a. In classrooms arranged as groups, children who were less aggressive at Time 1 showed greater aggression at T2 when they had aggressive seatmates. Figure 3b. In classrooms arranged as groups, children who were less aggressive at Time 1 showed greater aggression at T2 when they had popular aggressive seatmates.
Figure 4. Estimation of target child’s aggression at Time 2 based on popular seatmates’ aggression at Time 1 and target child’s popularity at Time 1 (rows). In classrooms arranged as rows, popular children were less aggressive when their popular seatmates were highly aggressive. Less-popular children were more aggressive when their popular seatmates were highly aggressive.
Figure 5. For less-popular children only, having highly prosocial seatmates was associated with greater prosocial behavior at Time 2.
Study 2

Responsive Teaching in the Elementary School Classroom:
Explaining Changes in Peer Community and Teacher Closeness using a Bifactor Model of the CLASS

A large and growing body of empirical evidence suggests that students who feel safe, supported, and cared about by the teacher, and who feel positive about the peer community in the classroom, also show elevated levels of learning engagement and academic achievement (Furrer & Skinner, 2003; Solomon, Battistich, Watson, Schaps, & Lewis, 2000). Correspondingly, researchers have suggested improving teacher-child relationships and sense of community as a means of improving educational outcomes (e.g., Danielson, Wiium, Wilhelmsen, & Wold, 2010; Hamre & Pianta, 2001; Osterman, 2000). However, there are unanswered questions about the nature of teacher practices that promote these kinds of student feelings of relatedness, and how they can be measured. Documenting and assessing the teacher practice associated with student feelings of relatedness is a critical first step to designing and evaluating interventions that strengthen those practices.

In recent years, the Classroom Assessment Scoring System (CLASS; Pianta, La Paro, & Hamre, 2008) has been widely used to characterize teacher-child interaction quality along three domains: emotional support, instructional support, and classroom organization. Two recent studies applying a bifactor model to the CLASS suggest that teacher-child interaction quality might more accurately be characterized by one broad aspect of teacher-child interactions, responsive teaching, along with more specific and distinct (uncorrelated) dimensions of teacher-child interaction quality that reflect management strategies and cognitive facilitation (Hamre, Hatfield, Pianta, & Jamil, 2014; Jones, Molano, Brown, & Aber, 2013).
The present study had three goals: 1) to replicate the bifactor model of the CLASS in a sample of elementary school classrooms and isolate a general factor of responsive teaching, 2) to determine the degree to which responsive teaching is linked with increases in student perceptions of relatedness with teachers and peers over the course of an academic year, and 3) to determine whether children or classrooms at elevated risk for low-quality teacher and peer relationships were differentially affected by responsive teaching.

The Importance of a Student’s Sense of Relatedness in the Classroom

A student’s sense of relatedness can be defined as a feeling of secure and satisfying connections with others (Connell & Wellborn, 1991; Deci, Vallerand, Pelletier, & Ryan, 1991). A sense of relatedness is a broad construct that encompasses several different types of interpersonal relationships. In the school setting, two aspects of relatedness are associated with student outcomes: perceived relatedness to the teacher (“teacher closeness”) and perceived relatedness to classmates (“peer community”). More specifically, perceived teacher closeness refers to the feeling of being safe, supported, and cared about by the teacher (Pianta, 2001). A sense of peer community refers to the belief that a child’s classmates respect each other and care about one another (Furrer & Skinner, 2003; Solomon et al., 2000).

Conceptual foundations. Self-systems and self-determination theories form the foundation for many studies of relatedness in the classroom (e.g., Connell & Wellborn, 1991; Deci et al., 1991; Furrer & Skinner, 2003; Skinner & Belmont, 1993). According to these theories, humans have three fundamental psychological needs: competence, autonomy, and relatedness. Children who perceive that their needs are met in the classroom should be engaged; for example, they should pay attention, participate in class, and be excited about learning. Children whose needs are not met become disaffected; they prefer easy work, skip class, and
experience boredom (Connell & Wellborn, 1991). The need for relatedness appears to be more important than competence and autonomy for children’s engagement in school, and perceiving relatedness may facilitate the fulfillment of both competence and autonomy (Grolnick, Ryan, & Deci, 1991; Skinner & Belmont, 1993).

In addition, researchers have extended attachment theory from its foundation in the parent-child relationship to include the teacher-child relationship, positing that close teacher-child relationships foster feelings of security at school that promote learning engagement (e.g., Hughes, Wu, Kwok, Villarreal, & Johnson, 2011; Jerome, Hamre, & Pianta, 2009). For example, based on Bowlby’s (1980) theory of internal working models of relationships, Hughes and colleagues (2011) posited that children form a mental representation of the teacher-child relationship based on accumulated experiences with different teachers, including the current teacher. Representations of a secure relationship with the teacher should allow the child to take risks, such as participating in challenging learning or social activities where there is a potential for failure (Birch & Ladd, 1997; Roorda, Yoomen, Spilt, & Oort, 2011).

**Empirical evidence linking relatedness with student outcomes.** Teacher reports of the closeness they feel in relationships with students are linked with increases over time in children’s liking for school, engagement, and even achievement (Birch & Ladd, 1997; O’Connor & McCartney, 2007; Pianta & Stuhlman, 2004). Fewer studies have assessed teacher-child closeness from the child’s perspective. Child-reported teacher closeness is associated with increased interest in class, competence beliefs, and academic motivation (Wenztel, Battle, Russell, & Looney, 2010; Hughes et al., 2011). A recent meta-analysis showed medium- to large effect sizes on the link between positive teacher-child relationships and students’ behavioral and emotional engagement (Roorda et al., 2011).
Furrer and Skinner (2003) provide strong evidence that a sense of relatedness to peers is also associated with greater engagement. Including both sense of relatedness to teachers and to peers as predictors, the authors found that peer relatedness was associated with children’s reports of behavioral and emotional engagement in the sixth grade. Peer relatedness also predicted teachers’ reports of children’s behavioral engagement. One cross-sectional analysis found a significant association between middle school students’ perceived support from classmates and their expectations for success in a particular subject, even after accounting for significant teacher support and sense of general belonging; however, peer support did not predict intrinsic valuing of learning (Goodenow, 1993).

**Teacher Responsiveness as Predictor of Children’s Sense of Relatedness**

Many child characteristics have a large influence on children’s relationship quality. Girls tend to have better relationships with their teachers, and aggressive children often struggle in their relationships with teachers and peers (Campbell, Spieker, Burchinal, Poe, & NICHD Early Child Care Research Network, 2006; Gest, Welsh, & Domitrovich, 2005). Children who experience rejection from their peers may also have a deflated sense of relatedness to teachers and peers, though this could be due to children’s behavior problems (Gest et al., 2005; Salmivalli & Isaacs, 2005; Wu, Hughes, & Kwok, 2010). Nonetheless, classrooms vary widely in their overall levels of teacher-child relationship quality and peer relationship quality, suggesting that variables at the classroom level might explain some differences in children’s relatedness (Danielsen et al., 2010).

**Conceptual foundations.** Just as sensitive, responsive parent-child interactions lead to more secure parent-child relationships (de Wolff & van IJzendoorn, 1997), responsive teaching may be linked with more teacher-student relatedness. Bornstein and colleagues define
responsiveness as caregivers’ “prompt, contingent, and appropriate reactions to their children” (Bornstein, Tamis-LeMonda, Hahn, & Haynes, 2008, p. 867). These three elements of responsiveness are essential: Caregivers must respond soon after a child’s bid (prompt), the response must be related to the child’s original bid (contingent), and the response must be positive and meaningful (appropriate; Bornstein et al., 2008). Bowlby (1982) suggested that children who experience responsive mother-child interactions believe that their mother will be available in times of distress, contributing to a secure attachment relationship. In fact, interventions focused on improving maternal responsiveness have successfully increased the likelihood that children develop a secure mother-child attachment relationship (Eshel, Daelmans, de Mello, & Martines, 2006).

Responsiveness may be an important aspect of teaching practice associated with student relatedness as well, though the relevant body of work is small and focused primarily on early childhood classrooms (Goosen & van IJzenzoorn, 1990; Hamre et al., 2013; Howes & Smith, 1995;). Howes and Smith (1995) used observations of teacher-child interactions to quantify teachers’ “positive social interactions,” similar to responsiveness. Positive social interactions were essentially those in which the teacher went beyond the minimum requirement for caregiving (e.g., not just wiping the child’s nose, but giving the child a hug). Positive social interactions were positively correlated with observed attachment security between teachers and children. The study only examined concurrent correlations without controlling for potentially confounding variables, but the findings suggest that teachers who are more responsive to their students may foster secure relationships.

More recently, Hamre and colleagues (2014) examined teacher responsiveness in a large sample of preschool classrooms. In their application of attachment theory to teacher-child
interactions, the authors defined responsiveness as teachers’ active engagement of students, successful detection of children’s cues, and contingent responding to children’s needs. Teacher responsiveness was linked to growth in cognitive ability and self-regulation, controlling for gender and ethnicity, among other confounds. Responsiveness was associated with less teacher-reported conflict with students across the year, but there was no effect of responsiveness on teacher-reported closeness with students.

Given the decline in teacher-child relationship quality found across elementary school and through middle school (Gest et al., 2005; Eccles & Roeser, 2009), a clear next step for research linking teacher responsiveness to students’ security is to consider students beyond the preschool years. This study focuses on elementary school classrooms and links observed responsiveness to students’ self-reported sense of relatedness. In addition, this study explores the potential link between teacher responsiveness and students’ sense of peer community. In a study of teachers who received professional development in providing more emotional support to their students, children were observed to have more positive interactions with one another, perhaps because they modeled the teachers’ warm interaction style (Mikami, Gregory, Allen, Pianta, & Lun, 2011). A small study has also shown that children who reported closer relationships with their teachers were less reactive to negative peer interactions (Little & Kobak, 2003). These findings suggest that teachers who have responsive interactions with their students may foster more satisfying relationships among their students, although this link has not been tested directly.

**Moderated effects.** For children who are at risk of developing negative relationships with teachers and peers, having a responsive teacher may be especially important. According to Pianta and Hamre’s (2005) academic risk model, the benefits of high-quality teaching may be
greatest for children who are at higher risk of academic failure. This study examines the possibility that teacher responsiveness has an amplified effect on children who are at greater risk for negative relationships, including boys, children with aggressive behavior, and children who are less preferred by their peers. It may also be that responsiveness is especially important in certain contexts, such as classrooms with less liking among students and classrooms with high overall levels of student aggression. To our knowledge, no studies have disentangled child-level and contextual-level effects of aggression and social preference on relatedness. However, evidence that aggressive classrooms lead to increases in children’s behavior problems, even for children who are not initially aggressive, suggests that contexts can be especially important for children’s development (Stormshak, Bierman, Bruschi, Dodge, & Coie, 1999).

**Measuring Teacher Responsiveness**

Assessing the level of responsiveness in teachers’ interactions is complicated, especially once children reach elementary school and the most prototypic caregiving interactions, such as comforting children, are less common. Moreover, observational measures of teacher-child interaction quality typically focus on the *intentions* of the teacher, such as organizing students, or on the *content* of the interactions, such as use of advanced vocabulary. Regardless of their intent and content, however, all interactions likely include some level of responsiveness (Hamre et al. 2014).

The belief that teacher responsiveness underlies all high-quality interactions led Hamre and colleagues (2014) to take a closer look at the Teaching through Interactions Framework and the CLASS observational measure. Under the framework, each of the domains of teacher-child interaction quality is based on three or four specific, observable dimensions of teacher-child interactions. *Emotional support* is based on indicators of positive and negative climate, teachers’
regard for student perspectives, and teachers’ sensitivity to student needs. *Instructional support* is based on teachers’ modeling of advanced language, development of academic concepts, and quality of feedback. Finally, *classroom organization* is based on teachers’ effective behavior management, productivity, and use of multiple, effective instructional learning formats (Hamre et al., 2013). Though each of the ten dimensions is based on different observable behaviors, studies consistently find high correlations among domains. For example, Hamre and colleagues (2014) found correlations ranging from .71 (between instructional support and emotional support) to .98 (between classroom organization and emotional support) in a sample of 314 preschool classrooms.

Methodologically, high intercorrelations among different aspects of teacher-child interactions make it difficult to test the distinctive importance of each domain. Substantively, and perhaps more importantly, these high intercorrelations indicate that some basic quality of teacher-child interactions may be present across the ten dimensions measured using the CLASS. The lack of a perfect correlation further suggests that there are still distinct, uncorrelated aspects of each domain (Hamre et al., 2013). Hamre and colleagues (2014) situate the problem of interdomain correlations in the debate over domain-general versus domain-specific elements of interactions.

One approach to reconciling findings of both domain-general and domain-specific aspects of teacher-child interactions is to apply a bifactor modeling strategy to the CLASS (Hamre et al., 2013). In a bifactor model, factor loadings are applied such that item variance is partitioned across a general factor as well as a number of specific factors. The general factor accounts for shared variance among variables—for example, in the CLASS, a general factor would account for the “common ground” across the ten dimensions of teacher-child interaction
quality. Any remaining variance that is shared across two or more variables can be accounted for by a number of specific factors (Chen, West, & Sousa, 2006; Hamre et al., 2013). A key element of the canonical bifactor model is that the general factor is uncorrelated with the specific factors (Chen et al., 2006). Typically, the specific factors are not allowed to correlate with one another, though theories specific to the research question may suggest that nonzero correlations should be modeled (Chen et al., 2006; Martel, von Eye, & Nigg, 2010).

Hamre and colleagues (2014) tested a bifactor model of the CLASS in a sample of 314 preschool classrooms. After several iterations, their final model included a general factor labeled *responsive teaching*, which captured aspects of responsiveness within each CLASS dimension (detecting cues, contingent responding, and engaging students), as well as two specific factors, *positive management and routines* and *cognitive facilitation* (Figure 1a). The orthogonal nature of the general and specific factors allowed Hamre and colleagues (2014) to include all three factors simultaneously in models predicting academic, self-regulatory, and social outcomes. With the shared variance removed, the specific factors predicted outcomes in the same domain. The general factor, responsive teaching, predicted a variety of changes in academic, self-regulatory, and social outcomes, consistent with the hypothesis that teacher-child interactions have a general factor that affects all aspects of development.

Jones and colleagues (2013) attempted to replicate the preschool bifactor model in an elementary school sample (grades 3–5). The structure found by Hamre and colleagues (2013) did not fit, but modifying the structure of the specific factors resulted in a much better fit (see Figure 1b). Importantly, the pattern of loadings defining the general factor of responsive teaching was very similar in the two studies. The major distinction was that the productivity and negative
climate dimensions loaded more strongly on Responsive Teaching in the elementary school sample, compared to the preschool sample.

**The Present Study**

The present study had three primary goals. The first aim was to estimate a bifactor model of the CLASS based on the models of Hamre and colleagues (2014) and Jones and colleagues (2013). At present, only two studies have examined bifactor models of the CLASS, and each have found a slightly different model, although each identified a broad factor representing responsive teaching. The hypothesis was that a broad general factor representing responsive teaching would emerge in this elementary school sample. The second aim was to examine the link between responsive teaching and changes in children’s sense of relatedness to teachers and peers over the course of an academic year. The hypothesis was that responsive teaching would promote positive changes in students’ feelings of relatedness to teachers and peers. The third aim was to explore moderation effects, to determine whether children or classrooms at elevated risk for low-quality teacher and peer relationships were differentially affected by responsive teaching. The hypothesis was that children and classrooms at greatest risk for low-quality relationships would benefit the most from responsive teaching.

**Methods**

**Participants**

Data were analyzed for 2,243 students (51% boys) enrolled in grade 1 (N = 703), grade 3 (N = 714), and grade 5 (N = 826). Participants were drawn from Years 2–4 of the Classroom Peer Ecologies Project, a multi-year study of teaching practices, peer relationships, and student outcomes. (Year 1 was a pilot study.) Each year, a set of classrooms was followed from fall to spring, with the broad goal of understanding how classroom relationships influenced children’s
development within a single school year. To provide a diverse sample, school districts were
drawn from rural areas, small to mid-sized cities, and an urban center in the Northeast and
Midwest of the United States.

The present study used assessments conducted in fall (Time 1) and spring (Time 2). The
original sample included 157 classrooms from 26 schools. Ten classrooms were excluded from
analyses: two teachers declined to continue participating, six classrooms had low participation at
Time 1 (fewer than 65% of students participating, diminishing the validity of peer-nomination
measures), and two classrooms with different teachers in the morning and afternoon (because a
single teacher’s interactions could not be linked to child outcomes). The final sample included
147 classrooms from 26 schools (48 1st grade, 48 3rd grade, and 51 5th grade; one 3rd grade
classroom also included 4th graders and one 5th grade also included 6th graders). Classroom
composition varied widely in terms of ethnic composition and parent education: mean percent
African American = 31% ($SD = 23\%$, range 0%–95%); mean percent Hispanic = 9% ($SD = 12\%$,
range = 0%–64%); mean percent of parents having a four-year college degree = 63% ($SD = 21\%$,
range 0%–100%).

**Procedures**

Teachers were approached regarding the study and provided informed consent. Parents
then received information about the study and provided consent for their child to participate.
Finally, children provided oral assent (in 1st grade) or written assent (in 3rd and 5th grade) prior to
taking the survey. The present study uses assessments from two time points: Time 1 (T1) data
were collected within two months of the first day of school and Time 2 (T2) data were collected
approximately 6 weeks before the end of the school year.
Classroom observations were conducted at T1. Student and teacher surveys were administered at both T1 and T2. In 3rd and 5th grade classrooms, trained research assistants read survey questions aloud and children were asked to indicate their responses on their surveys. To accommodate their limited reading ability, 1st graders were individually interviewed by trained research assistants. Teacher surveys were given to teachers around the same time as student surveys were administered.

Longitudinal Sample

At T1, 3,040 children were enrolled in the study classrooms. Of these, 2,673 (89%) had parent consent and 2,535 (83%) assented to participate. Classroom-level participation rates at T1 ranged from 65%–100% (M = 83%, SD = 9%). At T2, 2,310 (91%) of the children who participated at T1 were in the same classroom at T2 and assented to participate. Finally, 15 children had incomplete surveys, and ethnicity data were unavailable for 52 children, resulting in a final analytic sample of 2,243 children. In addition, parent education level was unavailable for 294 children. Rather than exclude these children, existing data from each classroom were used to calculate a classroom-level index representing the percent of students whose parents had a four-year college degree.

Measures

Teacher-child interactions: The CLASS measure. The Classroom Assessment Scoring System for grades K–3 was used to measure teacher-child interaction quality (CLASS K–3; Pianta, La Paro, et al., 2008). CLASS scores are based on the quality of interactions observed, rather than the frequency of each interaction. Each classroom was observed for four cycles, generally on a single day. Cycles consisted of 15-20 minutes of observation and up 10 minutes for scoring. Observers scored each of the ten dimensions (described above), watching for several
behavior indicators for each dimension. Scores for each dimension ranged from 1 (classroom is not characteristic of a classroom with this feature) to 7 (classroom is highly characteristic of a classroom with this feature).

Observers were trained in the CLASS and certified when they met the following reliability criteria: (a) at least 80% of their ratings across the five training videos were within one point of the gold standard, and (b) for each dimension, at least three of the five videos were scored within one point of the gold standard (i.e., observers were not systematically rating one or two dimensions incorrectly). In Years 2 and 3, nearly all CLASS cycles were scored by two observers. In Year 4, two observers took turns scoring the CLASS across four cycles. In half of those classrooms, both observers scored the CLASS during an extra (fifth) observational cycle so that reliability estimates could be calculated.

The dual-observer system maximized the reliability of the scores used in analyses, given that rater variance is a critical source of measurement error for the CLASS (Raudenbush, Martinez, Bloom, Zhu, & Lin, 2011). ICCs fell in the upper end of Fleiss’s (1986) “fair to good” range (positive climate = .89; negative climate = .82, teacher sensitivity = .81, regard for student perspectives = .81, behavior management = .89, productivity = .86, instructional learning formats = .83, concept development = .83, quality of feedback = .84, language modeling = .87). In Years 2 and 3, cycle-level scores were computed as the average of the two observers. The final score for each dimension was the average across the four cycle-level scores.

**Social relatedness: Teacher closeness.** *Teacher closeness* was conceptualized as the degree to which students perceived a warm, caring relationship with their teacher. Five items were adapted for student report from the Closeness subscale of the teacher-reported Student-
Teacher Relationship Scale (STRS; Pianta, 2001): “I trust my teacher,” “I like being around my teacher,” “My teacher is kind to me,” “I feel safe when my teacher is around,” and “My teacher respects me” ($\alpha = .87$). Responses ranged from 1 (never) to 5 (always).

**Social relatedness: Peer community.** Peer community was conceptualized as the degree to which students felt that their classroom was a place where children respected and helped one another. Five items, drawn primarily from the Sense of Community Scale (Battistich, Solomon, Kim, Watson, & Schaps, 1995) and reworded to focus on the classroom context rather than the school context, formed an internally consistent scale ($\alpha = .87$): “Kids in my classroom work together to solve problems,” “People care about each other in my classroom,” “Kids in my classroom do nice things for each other,” “Kids in my classroom help each other,” and “My teacher and classmates treat each other with respect.” Responses ranged from 1 (never) to 5 (always).

**Aggression and social preference.** At T1, participating children provided peer nomination data. For all items, children could name as many classmates as they desired and cross-gender nominations were allowed. To assess aggressive behavior, children were asked to identify classmates who fit the descriptions for two items: Fights (“These kids start FIGHTS. These kids push other kids around, or hit them or kick them” and “These kids SAY MEAN THINGS about other kids, and they spread nasty rumors about other kids” ($r = .82$). Two items assessed prosocial behavior: “These kids are always willing to do something NICE for somebody else, and are really nice people” and “These kids COOPERATE. Here are kids who really cooperate—they pitch in, share, and give everyone a turn” ($r = .82$). Class rosters were provided for 3rd and 5th graders to circle names; 1st graders recalled names from memory. Each item was transformed into a proportion score by dividing the number of nominations that a child received...
by the total number of participating children in the classroom. The proportion scores from each item were averaged to create the composite scales.

To assess social preference, participants were asked to name children for two questions: “These are the kid I would LIKE MOST to play with,” and “These are the kids I would LIKE LEAST to play with” ($r = -.37$). Proportion scores for LIKE LEAST were subtracted from proportion scores for LIKE MOST to create a social preference score.

**Control variables: Demographics.** Individual-level demographic covariates included child gender and minority status. At the classroom-level, controls included ethnic composition (percent minority), class size, grade level, and parent education (percent of children without a parent having a four-year college degree).

**Results**

**Estimating a Bifactor Model of the CLASS**

Correlations and descriptive statistics for the ten CLASS dimensions are presented in Table 1. The first goal of the study was to compute an index of teachers’ responsiveness in the classroom through the use of a bifactor model of the CLASS measure. To determine the optimal structure for the data, two different bifactor models of the CLASS were estimated using the structural equation modeling program LISREL (Joreskog & Sorbom, 1993). The first bifactor model was based on the structure found by Hamre and colleagues (2014) in their sample of preschool children (Figure 1a). The second bifactor model used the structure found by Jones and colleagues (2013) in their sample of elementary school children (Figure 1b). Both models allowed all dimensions to load on a responsive teaching factor, but each model specified the structure of the remaining variance in a slightly different way. In line with previous bifactor models of the CLASS, the correlations among the three factors were fixed to 0 (i.e., the factors
were orthogonal). The preferred model was determined by comparing three practical fit indices for each model: root mean square error of approximation (RMSEA), non-normed fit index (NNFI), and comparative fit index (CFI).

Results from the two bifactor models are presented in Table 2. Comparison of the RMSEA, CFI, and NNFI suggested that the second bifactor model (Jones et al., 2013) was the best fit to the data. In the first model (Hamre et al., 2014), none of the items loaded significantly on the factor labeled positive management and routines. In contrast, all factor loadings were significant in the second model. The largest loadings on the general factor came from positive climate and teacher sensitivity, suggesting that this is indeed a measure of teachers’ responsiveness to children.

The correlations among the three CLASS domains (as traditionally constructed) and the three bifactor scales are presented in Table 3. The high correlations among the three traditional CLASS domains reinforce the importance of creating orthogonal factors for the CLASS.

**Creating an Index of Responsive Teaching**

Factor score loadings were obtained from the preferred bifactor model. Standardized factor scores were then computed using the FSCORE application (Molenaar, 1996), which applied the loadings to the ten CLASS dimension scores for each classroom. Finally, the factor scores were rescaled using the weighted means and standard deviations of the ten CLASS dimensions. The goal was to facilitate interpretation of results by mirroring the original CLASS metric of 1–7. The final responsive teaching scale ranged from 1.16–6.69 ($M = 4.48$, $SD = 1.14$).

**Linking Responsive Teaching to Changes in Children’s Sense of Relatedness**
The second goal of this study was to determine whether teachers’ responsiveness was associated with gains in children’s perceptions of teacher closeness and peer community across a school year, and to identify both individual- and classroom-level moderators of this association.

**Preparing the data.** The aggression variable was positively skewed so it was square-root transformed. Classroom-level scores on aggression and social preference were calculated as the average of students’ scores. All continuous variables were then centered at their grand mean, which allowed us to control for both child- and classroom-level variables that might be confounded with the predictor (responsive teaching) and/or outcomes (teacher closeness; peer community). Zero-order correlations and descriptive statistics for child-level variables are presented in Table 4.

**Overview of modeling.** For each outcome, regression analyses were estimated using multilevel modeling in SAS Proc Mixed with a random intercept for classroom. Models were estimated using restricted maximum likelihood estimation. The significance of fixed effects was determined using Wald tests (i.e., estimate, SE).

The first model was an unconditional model with a random intercept only. This model provided an estimate of the proportion of variance in the outcome that was at the classroom level. The second model was a main effects model in which children’s outcomes were modeled as a function of their classroom’s responsive teaching score, classroom-level aggression, classroom-level social preference, child-level aggression, and child-level social preference. Additional control variables at the classroom level included grade, parent education (percent with a four-year college degree), percent African American, percent Hispanic, percent other ethnicity, and class size. Control variables at the child level included T1 score on the outcome, gender, and ethnicity. Several versions of this model were estimated, each with a different
random slope included: child-level aggression, child-level social preference, and gender. These models were compared to a random-intercept-only model using likelihood ratio tests (LRTs). Random slopes that significantly improved the model were retained.

Finally, the third model added interactions: responsive teaching X classroom-level aggression, responsive teaching X classroom-level social preference, and interactions between responsive teaching and child-level variables (aggression, social preference, gender). For parsimony, non-significant interactions were dropped from the final model.

**Responsive teaching predicting teacher closeness.** The unconditional model for teacher closeness found an intraclass correlation coefficient (ICC) of 0.16, indicating that 16% of the variance in children’s perceived teacher closeness was between classrooms.

In the second model, only the random slope for aggression improved the fit of the model and was retained (-2Δ LL(2) = 27.4, p < .001), indicating that the association between child-level aggression and teacher closeness varied between classrooms. The random slope for social preference had no variance, and gender slope did not significantly improve the model fit (-2Δ LL(2) = 1.7, p = .43). Results for the main effects model are presented in Table 5.

The third model initially included a cross-level interaction between responsive teaching and child-level aggression, a responsive teaching X classroom-level aggression interaction, and a responsive teaching X classroom-level social preference interaction. Only the responsive teaching X classroom-level aggression interaction was significant and retained in the final model, presented in Table 5.

After accounting for the strong stability in children’s teacher closeness, responsive teaching was associated with significantly greater teacher closeness. Moreover, an interaction between responsive teaching and classroom-level aggression indicated that in highly aggressive
classrooms, responsive teaching is especially beneficial to children’s perceived teacher closeness (see Figure 2). Greater individual-level aggression was associated with less teacher closeness. Finally, 1st graders perceived greater teacher closeness relative to 5th graders, whereas 3rd graders were not significantly different from 5th graders. There were no effects of child gender, child ethnicity, child social preference, class size, classroom-level social preference, classroom-level parent education, or classroom level ethnicity.

**Responsive teaching predicting sense of peer community.** The unconditional model for peer community indicated that 21% of the variance was between classrooms ($p < .001$). A series of LRTs in the main effects model indicated that none of the random slopes improved the model, indicating that the association between these child-level variables and sense of peer community were stable across classrooms (child-level aggression: $-2\Delta \text{LL}(2) = 0.5, p = .78$; social preference: $-2\Delta \text{LL}(2) = 2.5, p = .27$; gender: no variance). No random slopes were included in the final models.

The interaction between classroom-level social preference and responsive teaching was not significant and was thus dropped. Results from the final model are presented in Table 5. After accounting for children’s T1 score on sense of peer community, there was no main effect of responsive teaching on sense of peer community; however, a significant interaction between classroom-level aggression and responsive teaching indicated that responsive teaching was especially important in classrooms with greater levels of aggression (Figure 3). Again, 1st graders had a greater sense of peer community than did 5th graders. Individual-level aggression was unrelated to children’s sense of community.

**Post-hoc Analyses**
The interaction effects in both the teacher closeness model and peer community model revealed that children in aggressive classrooms were expected to have greater relatedness when their teachers were highly responsive. The negative correlation between responsive teaching and aggression, however, suggested that highly aggressive classrooms might not be benefiting from responsive teaching. To clarify the extent to which classrooms had different combinations of responsive teaching and aggression, classrooms were identified that had aggression scores that were low (one SD below the mean) or high (one SD above the mean). In the low aggression group, responsive teaching scores ranged from 2.25–6.69 \((M = 4.68, SD = 1.23)\). In the high aggression group, responsive teaching ranged from 2.04–5.48 \((M = 3.69, SD = 0.99)\). In other words, classrooms with higher levels of aggression tend to have low to average levels of responsive teaching. In the interaction plots (Figures 2 and 3), lines are truncated to include only combinations of responsive teaching and aggression that actually occurred in the sample.

**Discussion**

Previous research has shown that children who have positive relationships with their teachers and peers are more motivated and engaged in learning (Furrer & Skinner, 2003; Roorda et al., 2011). Moreover, teachers who have close relationships with their students feel more efficacious (Split et al., 2011). Though observations of teacher-child interactions are increasingly being collected as a measure of teacher quality, the focus has largely been on linking teacher-child interactions to children’s academic outcomes rather than relational outcomes. Using a sample of elementary school classrooms, the present study sought to explain the between-classroom differences in children’s sense of relatedness with an index of teachers’ responsiveness.

**Extracting Responsive Teaching from the CLASS Measure**
The first aim of the study was to replicate previous work on the bifactor model of the CLASS and extract a factor representing the responsiveness in teachers’ interactions with children. Correlations among the three CLASS domains suggested that there was some underlying factor present in all teacher-child interactions. Following the work of Hamre and colleagues (2014) and Jones and colleagues (2013), structural equation modeling was used to extract elements of responsiveness from each of the ten CLASS dimensions. Like both Jones et al. (2013) and Hamre et al. (2014), each of the ten CLASS dimensions in the present study loaded significantly on a general factor, labeled responsive teaching. The items with the largest loadings were heavily influenced by teachers’ responsiveness, emotional connection, and sensitivity (e.g., teacher sensitivity, positive climate, and instructional learning formats). For example, the instructional learning formats dimension addresses the teacher’s ability to engage students through the use of different learning modalities. Knowing how to engage students, and successfully do so, is an important component of teachers’ responsiveness (Hamre et. al., 2013).

Though the specific factors were not the focus of the present study, one of its accomplishments was that it replicated the structure of the bifactor model found by Jones and colleagues (2013). Both of the bifactor models compared in the present study were originally found through iterative processes, guided by the researchers’ theoretical rationales and resulting modification indices. The fact that the bifactor structure of Jones and colleagues was replicated in the present study suggests that the resulting structure fits well in different elementary school samples. The bifactor approach to modeling the CLASS in elementary school will allow researchers to study classroom management and cognitive facilitation as predictors of child outcomes, without concern that significant effects might be due to a teacher’s general level of responsiveness.
The differences between the structure found in the present study and that found by Hamre and colleagues (2014) in a preschool sample are worth noting. In the preschool structure, positive climate loaded significantly on the positive management and routines factor; in the present study, however, positive climate loaded only on the general factor of responsive teaching. It appears that classroom management in elementary school is largely focused on behavior management, and positive climate has little to do with whether the teacher successfully manages the behavior of the classroom. Another difference is that instructional learning formats loaded on the cognitive facilitation factor in elementary school, but not preschool. It appears that the use of different, effective learning formats co-occurs with interactions specifically designed to increase learning.

The finding of both general and specific factors of teacher-child interaction quality contributes to the debate regarding domain-general versus domain-specific benefits of social interactions (Hamre et al., 2014). According to a domain-general perspective on interactions, all high-quality interactions, regardless of their content, should promote students’ development across social, academic, and self-regulatory domains. In contrast, a domain-specific perspective states that interactions only benefit child development within the same domain. For example, emotionally-supportive interactions (social input) should foster children’s social development, but not their academic or self-regulatory development (Hamre et al., 2014; Downer, Sabol, & Hamre, 2010). In the present study, all ten dimensions of teacher-child interaction quality—whether focused on providing social support, academic development, or classroom management—contributed to a single factor representing the teachers’ responsiveness. In turn, this factor predicted important social outcomes for the student, suggesting that there are domain general aspects of interactions. Still, remaining variance in aspects of teacher-child interaction
quality was accounted for by specific factors of management and routines and cognitive facilitation. A domain-specific perspectives states that these factors should predict primarily self-regulatory and achievement outcomes, respectively (Downer et al., 2010); future research is needed to confirm specific associations.

**Linking Teacher Responsiveness to Children’s Sense of Relatedness**

The second aim of this study was to explore whether responsive teaching might foster close relationships between teachers and children, and potentially among peers. The index of responsive teaching estimated using the bifactor model was used to predict changes in children’s self-reported closeness to the teacher and sense of community among peers.

**Teacher closeness.** As hypothesized, the main effects model showed that responsive teaching was positively associated with changes in teacher closeness. When teachers exhibit the key elements of responsiveness, such as detecting children’s cues, engaging students, and appropriately responding to their needs and interests, children perceive secure and satisfying relationships with their teachers. The findings from the present study differ from those of Hamre and colleagues (2014), who found no effect of responsive teaching on changes in teacher reports of the teacher-child relationship quality in a large preschool sample.

Earlier work using pilot data from the same study revealed concurrent associations between one aspect of the CLASS—emotional support—and children’s reports of teacher closeness (Madill, Gest, & Rodkin, 2014). The results from the present set of analyses suggest that the conclusions of the previous study are correct, but are perhaps overly narrow. That is, instead of only emotional support affecting children’s relatedness to teachers and peers (indexed by the four items of positive climate, negative climate, teacher sensitivity, and regard for student
perspectives), the present findings suggest that aspects of all ten qualities of teacher-child interaction might influence perceived teacher closeness and peer community.

**Peer community.** Also as hypothesized, the main effects model showed significant, positive effects of responsive teaching on changes in children’s sense of peer community. There are at least two explanations for this effect. First, children may model their teachers’ interaction style when interacting with peers (Mikami et al., 2011). If teachers interact with students in a way that communicates caring, trust, and sensitivity, children may interact with one another in a similar manner. Second, findings from attachment theory suggest that children who have secure maternal attachment relationships have more positive peer experiences, perhaps because having a secure base allows them to explore their environment more (Schneider, Atkinson, & Tardif, 2001). It could be that responsive teacher-child interactions provide the same kind of secure base, which would allow children to interact with one another confidently. Indeed, Little and Kobak (2003) found that children who perceived close relationships with their teachers were less reactive when they had a negative peer experience, compared to children who had poor relationships with their teachers.

**Moderated effects of responsive teaching.** Moderation analyses examined whether the effect of responsive teaching was strongest for children at risk of having low-quality relationships with teachers and peers. Only one interaction was significant: For both teacher closeness and peer community, the effect of responsive teaching was largest in classrooms with the highest average aggression. Classrooms with low levels of aggression actually showed high relatedness regardless of the responsive teaching score.

Teachers frequently discipline aggressive children (Sutherland, 2000), which likely makes it difficult for teachers to form close relationships with aggressive children. Indeed, child-
level aggression was negatively associated with teacher closeness across the school year.

Interestingly, though, the compensatory effect of responsive teaching functioned not for individual children who were more aggressive that their peers, but for classrooms that were highly aggressive. The results suggest that teachers take different approaches to handling aggressive classrooms, and these strategies could affect the quality of teacher-child relationships that form in the classroom. Teachers who are less responsive may disconnect from students when they have aggressive classrooms, because the classroom is a source of stress. In contrast, more responsive teachers continue to engage with their students in spite of the difficult behavior.

Responsive teachers also seem to help aggressive classrooms form strong peer communities. Again, the benefit may be due to teachers’ different strategies for dealing with aggressive children. When teachers react strongly and negatively to a misbehaving child, it may shape other children’s views of aggressive children. Others have shown that teaching strategies can change the way that aggressive children are viewed by peers. For example, one study of elementary school classrooms found that when teachers favored more academically-oriented students, and were less learner-centered in their teaching strategy, children with externalizing behavior problems were even more likely to be rejected by their peers (Mikami, Griggs, Reuland, & Gregory, 2012). Another study of second grade students showed that the association between children’s aggression and tendency to be disliked by peers was mediated by teachers’ greater corrective and negative behavior towards aggressive children (McAuliffe, Hubbard, & Romano, 2009).

There is a potential danger in creating a strong sense of community among aggressive children. When children feel like they are part of a community, they are more likely to conform to the norms of that community (Osterman, 2000; Solomon, Watson, Battistich, Schaps, &
Delucchi, 1996). It is possible that creating a sense of community in an aggressive classroom makes aggression seem normal and valued. Children who are trying to increase their status may then adopt these behaviors (Dijkstra, Lindenberg, & Veenstra, 2008).

Close examination of the data suggest that classrooms with a large number of aggressive students tend to have lower levels of responsive teaching, compared to less aggressive classrooms. The benefit of responsive teaching to aggressive classrooms remains, but the lack of responsiveness in many aggressive classrooms is worth considering. It may be that responsive teaching is an effective behavior management strategy: Teachers who are responsive might prevent children from fighting and spreading rumors in the first place. If responsive teachers are more in tune with their students’ needs, they may catch social problems before they develop into major concerns like bullying relationships. Alternately, teachers may struggle to actually be responsive in the face of a highly aggressive classroom. Frequent behavior problems in the classroom are associated with teachers’ poor self-efficacy for classroom management (Klassen & Chiu, 2010). In fact, difficulty managing behavior problems is one of the main causes of the high teacher turnover plaguing schools (Ingersoll & May, 2012). It is likely that both explanations for the lack of responsiveness in aggressive classrooms play some role.

Implications

Results from the bifactor model suggest that teachers’ interactions with students should not be completely compartmentalized into emotionally supportive interactions, instructionally supportive interactions, and management-oriented interactions. Instead, in all of their interaction with children, teachers have the potential to be highly responsive. In other words, teachers should be aware that responsiveness is not limited to non-academic interactions with students.
Teachers can focus on engaging students during feedback loops, tuning in to the cues that students are sending with their behaviors, and responding appropriately to students’ concerns.

Results from predictive models suggest that responsive teaching may be an important piece of supporting children’s sense of relatedness, especially in classrooms that contain many aggressive students. Furthermore, teachers with aggressive classrooms seem to struggle with being responsive. Professional development efforts should focus on improving teachers’ ability to interact with aggressive students, as well as to manage the stress that comes from having difficult students.

**Limitations and Future Directions**

The number of classrooms in each grade did not allow for comparing the fit of the bifactor model across grades. It is possible that the model found in the present study fits best in the upper grades (i.e., 3rd and 5th grade), while the 1st grade may conform more to the structure found by Hamre and colleagues (2014) in the sample of preschool classrooms. Future work should test the structure of the bifactor model using a larger sample of same-grade classrooms.

Another limitation is that baseline child-report scores may already have been influenced by the teachers’ responsiveness. Though child surveys were collected early in the school year, it is likely that children are influenced by the climate set by the teacher within just the first few weeks of school. Future work could use baseline scores from the previous year to determine whether children’s perceptions of teacher closeness and sense of peer community increase when they change to a classroom with more responsive teaching.

Finally, intervention work will be necessary to determine whether increasing teachers’ responsiveness actually improves children’s relationships with their teachers and peers in highly aggressive classrooms. The MyTeachingPartner intervention, for example, seeks to improve
teachers’ provision of high-quality interactions based on the ten CLASS dimensions (Mashburn, Downer, Hamre, Justice, & Pianta, 2010). It will be interesting to see whether teachers who received the training were successful in implementing the strategies in aggressive classrooms. Intervention work will also be useful in determining whether responsive teaching can be improved in classrooms with other risk factors for negative relationships with teachers and peers. If responsive teaching is merely a teachers’ reaction to a group of students who are easy to relate to (that is, causation in the opposite direction), researchers will need to identify other strategies for improving classroom relationships. The present study controlled for baseline relationships, as well as a number of demographic confounds, so the findings are fairly robust for a naturalistic study.

In sum, the bifactor modeling strategy is a promising approach to the use of teacher-child interaction data assessed using the CLASS. Responsive teaching, in turn, appears to have an important benefit for children’s relationships with their teachers and peers. In an age when standardized tests dominate educational discussions, it is important to remember that helping teachers respond to their students’ needs continues to play a significant role in students’ development.
References


Ingersoll, R. M., & May, H. (2012). The magnitude, destinations, and determinants of


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between behavior problems and peer preference in different classroom contexts. *Child Development*, 70, 169-182.


### Table 1

**Correlations and Descriptive Statistics for CLASS Dimensions**

<table>
<thead>
<tr>
<th>CLASS Dimensions</th>
<th>1</th>
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<th>7</th>
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<tr>
<td>1. Positive climate</td>
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<td>2. Negative climate</td>
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<td>3. Teacher sensitivity</td>
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<td>4. Regard for student perspectives</td>
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<td>6. Productivity</td>
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<td>.77</td>
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<td>8. Concept development</td>
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<td>9. Quality of feedback</td>
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<td>.54</td>
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<td>.54</td>
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<td>Mean</td>
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<td>6.72</td>
<td>4.68</td>
<td>3.83</td>
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<td>4.39</td>
<td>3.30</td>
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<td>SD</td>
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<td>0.93</td>
<td>0.88</td>
<td>1.03</td>
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**Notes.** N=147 classrooms. All correlations are significant at p < .001.
<table>
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<tr>
<th>CLASS Dimensions</th>
<th>Model 1</th>
<th>Model 2</th>
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<td></td>
<td>Responsive Teaching</td>
<td>Positive Management and Routines</td>
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<tr>
<td>Positive climate</td>
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<td>β</td>
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<td>Language modeling</td>
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Model Fit

| CFI                           | 0.97                      | 0.97                      |
| RMSEA (CI)                    | 0.13 (0.10 - 0.16)        | 0.11 (0.09-0.14)          |
| NNFI                          | 0.95                      | 0.96                      |

Notes. N = 147 classrooms. Models 1 and 2 are based on structures found by Hamre et al., 2013 and Jones et al., 2013, respectively. CLASS = Classroom Assessment Scoring System; CFI = comparative fit index; RMSEA = root mean square error of approximation; NNFI = Non-normed fit index.

*a Coefficient not significant at p < .05
Table 3

*Correlations and Descriptive Statistics for CLASS Domains and Bifactor Scales*

<table>
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<tr>
<th>CLASS Domains</th>
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*Notes.* N=147 classrooms. All correlations are significant at *p* < .001 unless otherwise specified.

*Not significant at *p* < .05.*
Table 4
Correlations and Descriptive Statistics For Child- and Classroom-level Variables

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<td>1. T1 Teacher Closeness</td>
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<tr>
<td>2. T3 Teacher Closeness</td>
<td>0.50</td>
<td>--</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3. T1 Peer Community</td>
<td>0.40</td>
<td>0.28</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4. T3 Peer Community</td>
<td>0.27</td>
<td>0.48</td>
<td>0.52</td>
<td>--</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>5. T1 Aggression(^a)</td>
<td>-0.19</td>
<td>-0.22</td>
<td>-0.15</td>
<td>-0.12</td>
<td>--</td>
<td></td>
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</tr>
<tr>
<td>6. T1 Social Preference</td>
<td>0.17</td>
<td>0.14</td>
<td>0.12</td>
<td>0.06</td>
<td>-0.39</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Classroom-level Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Responsive Teaching</td>
<td>0.09</td>
<td>0.16</td>
<td>0.16</td>
<td>0.18</td>
<td>-0.07</td>
<td>0.09</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Classroom-level Aggression(^a)</td>
<td>-0.12</td>
<td>-0.17</td>
<td>-0.25</td>
<td>-0.28</td>
<td>0.44</td>
<td>-0.16</td>
<td>-0.21</td>
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<td></td>
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<tr>
<td>9. Classroom-level Social Preference</td>
<td>0.09</td>
<td>0.11</td>
<td>0.17</td>
<td>0.20</td>
<td>-0.21</td>
<td>0.40</td>
<td>0.21</td>
<td>-0.41</td>
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<tr>
<td>Mean</td>
<td>4.44</td>
<td>4.31</td>
<td>3.68</td>
<td>3.56</td>
<td>0.11(^b)/0.26(^c)</td>
<td>0.06</td>
<td>4.48</td>
<td>0.12(^b)/0.27(^c)</td>
<td>0.06</td>
</tr>
<tr>
<td>SD</td>
<td>0.75</td>
<td>0.90</td>
<td>0.97</td>
<td>0.99</td>
<td>0.14(^b)/0.21(^c)</td>
<td>0.29</td>
<td>1.14</td>
<td>0.06(^b)/0.10(^c)</td>
<td>0.11</td>
</tr>
</tbody>
</table>

Notes. \(N_{children} = 2243; N_{classrooms} = 147\). All correlations are significant at \(p < .01\) or smaller.

\(^a\)Aggression scores were square-root transformed.

\(^b\)Prior to transforming. \(^c\)After transforming.
### Table 5
Multilevel Models Examining Responsive Teaching as a Predictor of Teacher Closeness and Sense of Peer Community at Time 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Teacher Closeness</th>
<th>Peer Community</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Main Effects</td>
<td>Moderation</td>
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<tr>
<td>Intercept</td>
<td>4.21*** (0.05)</td>
<td>4.22*** (0.05)</td>
</tr>
<tr>
<td>Time 1 score on outcome</td>
<td>0.53*** (0.02)</td>
<td>0.53*** (0.02)</td>
</tr>
<tr>
<td>Gender: Girl</td>
<td>0.03 (0.03)</td>
<td>0.03 (0.03)</td>
</tr>
<tr>
<td>Ethnicity (White = reference)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>0.02 (0.04)</td>
<td>0.02 (0.04)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.04 (0.06)</td>
<td>0.04 (0.06)</td>
</tr>
<tr>
<td>Other</td>
<td>0.05 (0.06)</td>
<td>0.05 (0.06)</td>
</tr>
<tr>
<td>Aggression</td>
<td>-0.40*** (0.11)</td>
<td>-0.40*** (0.11)</td>
</tr>
<tr>
<td>Social preference</td>
<td>0.01 (0.06)</td>
<td>0.01 (0.06)</td>
</tr>
<tr>
<td>Class Size</td>
<td>-0.01 (0.01)</td>
<td>-0.01 (0.01)</td>
</tr>
<tr>
<td>Grade (5th = reference)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>0.20** (0.06)</td>
<td>0.20*** (0.06)</td>
</tr>
<tr>
<td>3rd</td>
<td>0.09 (0.06)</td>
<td>0.08 (0.06)</td>
</tr>
<tr>
<td>Percent African American</td>
<td>-0.20 (0.13)</td>
<td>-0.18 (0.13)</td>
</tr>
<tr>
<td>Percent Hispanic</td>
<td>-0.12 (0.24)</td>
<td>-0.16 (0.24)</td>
</tr>
<tr>
<td>Percent other ethnicity</td>
<td>-0.36 (0.30)</td>
<td>-0.36 (0.30)</td>
</tr>
<tr>
<td>Parent education: % with 4-year college degree</td>
<td>-0.003 (0.125)</td>
<td>-0.01 (0.30)</td>
</tr>
<tr>
<td>Classroom aggression</td>
<td>-0.12 (0.32)</td>
<td>0.03 (0.32)</td>
</tr>
<tr>
<td>Classroom social preference</td>
<td>0.05 (0.28)</td>
<td>0.16 (0.28)</td>
</tr>
<tr>
<td>Responsive Teaching (RT)</td>
<td>0.04* (0.02)</td>
<td>0.05* (0.02)</td>
</tr>
<tr>
<td>RT X Classroom aggression</td>
<td>0.43* (0.21)</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Residual variance</th>
<th>Est.</th>
<th>SE</th>
<th>Est.</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.05*** (0.01)</td>
<td></td>
<td>0.03*** (0.01)</td>
<td></td>
</tr>
<tr>
<td>Aggression (Child level)</td>
<td>0.32* (0.15)</td>
<td>0.30* (0.15)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes. +p < .10, *p < .05, **p < .01, ***p < .001. N = 2242 (Peer Community model) - 2243 (Teacher Closeness model) children, 147 classrooms.
Figure 1. Measurement models based on the ten CLASS dimensions. Figure 1a. The final bifactor model of Hamre and colleagues (2014) based on data from preschool classrooms. Figure 1b. The final model of Jones and colleagues (2013) based on data from third through fifth grade classrooms.
Figure 2. Estimation time 2 teacher closeness based on time 1 responsive teaching and classroom-level aggression. In classrooms with greater levels of aggression, responsive teaching is positively associated children’s perceptions of teacher closeness. In classrooms with low levels of aggression, teacher closeness does not depend on responsive teaching. Lines are truncated where no classrooms exist to avoid extrapolating beyond the data set.
Figure 3. Estimation time 2 peer community based on time 1 responsive teaching and classroom-level aggression. In classrooms with greater levels of aggression, responsive teaching is positively associated children’s sense of peer community. In classrooms with low levels of aggression, sense of peer community does not depend on responsive teaching. Lines are truncated where no classrooms exist to avoid extrapolating beyond the data set.
Conclusions and Implications

This dissertation examined how social interactions in the elementary school classroom are associated with children’s social development across two broad domains: children’s social behaviors, including aggressive and prosocial behavior, and children’s social relationships, including their perceptions of teacher closeness and peer community. Specifically, we examined two types of teaching strategies expected to influence social development. Specific strategies are those in which teachers actively manipulate children’s potential for interactions in order to achieve a specific behavioral or academic goal. General strategies are ways that teachers, through regular instructional processes, influence the social development of their students in addition to the academic development (Gest & Rodkin, 2011). Across these studies, the focus was on interactions between teachers and students as well as interactions among peers. According to a bioecological perspective on development, these interactions—or proximal processes—are key to the transmission of knowledge and behaviors (Bronfenbrenner & Morris, 2006).

Direct and Indirect Strategies: Evidence for Effectiveness in the Classroom

Both studies in this dissertation captured the complicated and serious nature of aggression in the elementary school classroom. As Farmer (2000) pointed out, children’s aggressive behaviors can elicit a host of reactions from one’s environment. In Study 1, aggressive behavior was more stable in group arrangements compared to row arrangements, perhaps because aggressive behaviors elicited reinforcing responses from classmates when the setting allowed for more peer interactions. Popular aggressive children even seemed to foster aggressive behavior in seatmates who were initially low in aggression. In Study 2, aggressive children had less-close
relationships with their teachers, and classrooms with more aggressive children experienced less responsive teaching.

One direct strategy for reducing aggressive behavior and promoting prosocial behavior has been the strategic use of the classroom seating arrangement. A major limitation of this strategy, however, has been the lack of empirical research on how seating arrangements influence social behavior, other than disruptive and off-task classroom behavior (Wannarka & Ruhl, 2008). As we found in Study 1, the natural tendency is for teachers to separate aggressive children. Findings indicated, though, that improving behavior is not as simple as placing an aggressive child with an unaggressive child. While this strategy might reduce disruptive behavior (which we did not test), there was no evidence that it improved aggressive behavior.

Even though children spend a great deal of time in the classroom, friends and peer groups are extremely powerful influences on children’s social behavior (Brechwald & Prinstein, 2011). The findings of Study 1 suggest that knowledge of such classroom social dynamics may be an importance element of the effective use of direct strategies for behavior management (Farmer, 2000). Seating arrangements should be seen not just as a way to reduce disruptive behavior during instructional time, but as a way to modify the peer group in a permanent way (Pearl, Leung, van Acker, Farmer, & Rodkin, 2007). While some basic behavioral processes such as provocation and reinforcement may take place in the seating arrangement to contribute to the maintenance of children’s aggressive behaviors, more complex processes such as friendship formation could be responsible for significant changes in behavior. It will be important for research to further examine the role of classroom social dynamics in the effects of seating proximity.
Whereas teachers’ direct strategies, including as seating arrangements, seek to manipulate the interactions in the classroom, indirect strategies can take advantage of existing interactions between teachers and children to improve classroom experiences (Gest & Rodkin, 2011). The results of Study 2 suggest that teachers who are highly sensitive, engaging, and responsive to their students can support the development of closer teacher-child relationships as well as a stronger sense of peer community, especially in classrooms with many aggressive children. Responsive teachers communicate that they care about their students and lead their students to feel close to their teachers (Hamre, Hatfield, Pianta, & Jamil, 2014). Perhaps most surprisingly, responsive teachers seem to help aggressive classrooms develop a sense of community.

In the past decade, teacher-child interactions have been typically been classified based on the intention or content of the interactions (Hamre et al., 2014). Using a bifactor model, as in Study 2, reveals the importance of all teacher-child interactions for children’s relationships: all ten types of interactions as measured using the CLASS (Pianta, La Paro, & Hamre, 2008) seem to have some underlying element of responsiveness, which we then linked to teacher-child closeness and peer community. Responsive parent-child interactions have been examined in great detail under an attachment perspective (de Wolff & van IJzendoorn, 1997), and it appears that responsive teacher-child interactions warrant future research, especially among older students.

**Changes in Children’s Experiences within a Single School Year**

In both Study 1 and Study 2, children’s baseline levels of behavior or relationship quality were included as covariates as we examined the additional variance accounted for by seatmate behavior and responsive teaching. Despite the high stability of aggressive behavior, prosocial behavior, teacher closeness, and peer community, we found a number of features of the
classroom that had significant effects on changes in children’s experiences. In Study 1, only approximately four months had passed between the initial assessment of behavior and the follow-up, yet changes were detectable in children’s aggressive as well as prosocial behaviors. In Study 2, one limitation was that children’s relationship quality may already have been impacted by the teachers’ level of responsiveness; nonetheless, responsive teaching predicted additional change in children’s experiences across the year.

Taken together, these studies confirm the importance of children’s experiences—specifically, their interactions with teachers and peers—within a single school year, because these interactions accounted for change in several outcomes that were already quite stable. The evidence for malleability in children’s behaviors and social relationships is a positive finding and indicates that researchers are justified in designing interventions to target these outcomes. These findings also serve as a reminder of children’s sensitivity to their environment (Bronfenbrenner & Morris, 2006): Without a supportive environment consisting of beneficial peer interactions and responsive teacher interactions, children may not develop to their full potential.

**Implications and Future Directions**

The studies in this dissertation suggest that it is important to study children’s interactions across a variety of settings, especially settings that allow interactions to be manipulated. Though research has focused extensively on the importance of friends and peer groups for behavior (Brechwald & Prinstein, 2011), there is still much work to be done on how to effectively change affiliative ties. It will be important to focus research on settings that can easily be changed, such as seating arrangements (van den Berg, Segers, & Cillessen, 2012). Teacher-child interactions should theoretically be easier to change, because it is just one teacher per classroom of twenty or more children. Interventions such as MyTeachingPartner (Mashburn, Downer, Hamre, Justice, &
Pianta, 2010) will be important for changing the way that teachers interact with their students. Future research should examine whether teachers can improve their responsiveness when interacting with aggressive students, or whether different strategies are needed to facilitate these interactions.

A second implication of this dissertation is that current approaches to managing children’s social behavior should be expanded to include more indirect strategies. Focusing on teacher-child interaction quality is likely not the first choice of schools aiming to improve peer climate in an aggressive classroom. However, we find that aggressive classrooms are at the greatest risk of having poor peer community, and that a responsive teacher can bring these students to the same level of peer community as their non-aggressive counterparts. Future research is needed to determine whether increasing peer community in aggressive classrooms also decreases aggressive behavior, or actually has an iatrogenic effect by further supporting norms for aggression (Osterman, 2000).

In conclusion, the studies in this dissertation found that elementary school classrooms are extremely social environments, and that the interactions that take place between teachers and students, as well as among peers, seem to influence children’s behavior and social relationships. More research is needed to determine exactly how seating arrangements and teacher-child interactions foster children’s positive development, and this dissertation has suggested a number of directions for this important work.
References


Pearl, R., Leung, M-C., van Acker, R., Farmer, T. W., & Rodkin, P. C. (2007). Fourth- and fifth-


VITA
Rebecca A. Madill

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Graduate Student Researcher—The Head Start REDI Project
2012-present

Supervisor: Karen Bierman, Ph.D.

- Plan and conduct analyses of longitudinal data to examine bidirectional associations between children’s social competences and academic skills (preschool through elementary school)
- Disseminate research by presenting at the conference of the Society for Prevention Research