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Selection and Socialization of Aggressive and Prosocial Behavior: The Moderating Role of Social-Cognitive Processes

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This study evaluated the extent to which fourth-grade students (*M* age = 8.62) select and are influenced by their peers' aggressive and prosocial behavior and the extent to which intra-individual social cognitions moderate these processes. Two waves of data were collected in the fall and spring of one academic year from children attending 18 New York City public elementary schools. Stochastic actor-based social network analysis was used to evaluate whether participants modify their network or behavior in response to the behavior of their peers. Findings support an average main effect of peer influence of aggression, as well as an interaction indicating that participants with high levels of hostile attributional bias have higher odds of adopting the aggressive behavior of their peers.

Children and adolescents exert powerful influences on the development of their peers. Because aggression is a particularly salient risk factor during this developmental period (Jones, Brown, Hoglund, & Aber, 2010; Masten & Wright, 2009), the influence of peers on aggressive behavior has received particular attention in the literature. Evidence obtained through the application of innovative analytic techniques, like social network analysis (Snijders, Steglich, & van de Bunt, 2010; Steglich, Snijders, & Pearson, 2010), highlights the tendency of children and adolescents to form social relationships with peers exhibiting similar behaviors (an illustration of a similarity-based *selection process*, Dishion, Patterson, & Griesler, 1994; Logis, Rodkin, Gest, & Ahn, 2013; Sijtsema et al., 2010), as well as their propensity to change their own behavior due to the influence of their peers (an illustration of an *influence or socialization process*, Logis et al., 2013; Sijtsema et al., 2010). More recent evidence has suggested that these processes do not affect equally all children, and that demographic characteristics (Brechwald & Prinstein, 2011), patterns of social representation (Dishion & Tipsord, 2011), and the forms and functions of the social behavior under study may generate heterogeneity in the magnitude and direction of these effects (Sijtsema et al., 2010; Veenstra & Dijkstra, 2011; Veenstra & Steglich, 2012).

Unfortunately this important work on the domain of aggression has not been accompanied by an equivalent exploration on domains that might serve as protections against risk or that might promote positive development (Tseng & Seidman, 2007). Whereas in the prevention science literature, multiple reports emphasize the development of prosocial and helping behaviors as strategies to protect at-risk adolescents (e.g., Centers for Disease Control & Prevention, 2009), little research has explored the ways in which influence (or selection) processes might be related to the transmission of prosocial and helping behavior in social groups (see Logis et al., 2013 in this special issue).

Capitalizing on recent advances in methodological approaches to distinguish selection from influ-

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ence (Snijders et al., 2010; Steglich et al., 2010) this article responds to a gap in the literature by exploring peer processes for antisocial and prosocial forms of behavior. Specifically, in a population of urban fourth-grade students in New York City, we examine (1) the incidence of selection and influence in two primary dimensions of social behavior simultaneously, and (2) the moderating role of individual social cognitions in these selection and influence processes. Here, aggressive and prosocial behaviors are conceptualized as a set of parallel and correlated outcomes that are (1) salient in the daily lives of early adolescents (Choi, Johnson, & Johnson, 2011), (2) fundamental to the overall functioning of educational and peer environments (Brion-Meisels & Jones, 2011), and (3) frequently targets of educational interventions that seek to promote positive development for high-risk youth (e.g., Jones, Brown, & Aber, 2011; Jones et al., 2010; Social & Character Development Research Consortium, 2010).

We also examine potential heterogeneity in these effects associated with individual differences in children's social cognitions, a set of processes understood to be central in the choice and enactment of social behavior in problem-solving situations (Crick & Dodge, 1994; Snyder et al., 2010). We focus on the extent to which individual differences in hostile attributional bias (Crick & Dodge, 1994), defined as the tendency to interpret ambiguous social interactions as intentionally harmful, moderates the effects of selection and influence processes in aggressive behavior. Simultaneously, we test for moderation of selection and influence in prosocial behavior using the reported *cognitive salience of prosociality* (hereafter referred to as prosocial cognitions), a construct defined by Rosenfeld, Huesmann, Eron, and Torney-Purta (1982) as the tendency to imagine and daydream about scenarios to help others.

PEER EFFECTS ON SOCIAL BEHAVIOR

The nature of aggressive and prosocial behavior across the developmental periods of childhood and adolescence has received attention in the academic literature. At a conceptual level, aggressive and prosocial behavior have been described as two distinct, but overlapping dimensions that can be enacted by the same individual (Card, Stucky, Sawalani, & Little, 2008; Veenstra et al., 2008) in response to the social structures and transactions in which he or she is involved at a given point in time (Sameroff & McKenzie, 2003; Sorlie, Hagen, & Ogden, 2008). Developmentally, for a population of urban and at-risk children, Aber, Brown and Jones (2003) present evidence of distinct but correlated linear and curvilinear trajectories of prosocial and aggressive behavior over the elementary school years. The authors report positive growth in aggressive behavior, peaking at age 10 and then decelerating, and positive growth of prosocial behavior that is at its lowest point at the age of 7.5 years and accelerates from there onward.

The influence of peers has been described as a fundamental input of the correlated development of these two forms of social behavior (Brechwald & Prinstein, 2011; Dishion & Tipsord, 2011), while characterizing the maintenance of close social relationships with peers as a central task of early adolescence (Brion-Meisels & Jones, 2011). From this framework, current evidence tentatively supports the theory that these two behaviors may be similarly susceptible to peer influence. For example, Adams, Bukowski, and Bagwell (2005) suggest that nonaggressive peers influence their aggressive friends in a positive way, reducing their aggressive behavior across two measurement points. In addition, Barry and Wentzel (2006) found that prosocial behavior increased across two time points for adolescents with social ties to peers who were more prosocial than themselves, and Hanish, Martin, Fabes, Leonard, and Herzog (2005) and Sijtsema et al. (2010) report the existence of a peer influence effect for aggression that exists beyond a tendency to form relationships with similar others.

Despite previous work, it is still not clear whether children consider the prosocial behavior of their peers as a criterion on which to select their social ties, and if so, how this characteristic fares in relation to other attributes of potential peers (e.g., aggressive behavior and gender). Prior work also, has not clarified the extent to which children are motivated to modify their own prosocial behavior in line with that of their closest peers, after accounting for potential selection processes. More importantly, and considering both forms of social behavior, prior work has not described the degree to which aggressive and prosocial behavior are adopted simultaneously from peers, perhaps responding to the differential status and salience of these behaviors among youth in a social context (Brechwald & Prinstein, 2011).

SOCIAL COGNITION AS A MODERATOR OF PEER EFFECTS

Previous work postulates that characteristics of the individual and his or her peers, and features of the social relationships and the context, may moderate processes of peer influence and selection (Brechwald & Prinstein, 2011; Dishion & Tipsord, 2011; Prinstein, 2007). Whereas some literature on peer influence has highlighted the roles of gender, social status, and reciprocity in relationships as potential moderators (Dijkstra, Berger, & Lindenberg, 2011; Knecht, Snijders, Baerveldt, Steglich, & Raub, 2010; Sijtsema et al., 2010), to our knowledge little research has explored the potential heterogeneity in selection and influence that is associated with individual differences in social cognition (Dishion & Connell, 2006; Goodnight, Bates, Newman, Dodge, & Pettit, 2006).

Social-cognitive processes, broadly defined as intra-individual patterns of attention, representation, and manipulation of stimuli from the social environment, have been described as a primary mechanism in the link between exposure to environmental risks, including exposure to peer aggression, and the development of antisocial and prosocial behavior (Aber et al., 2003; Crick & Dodge, 1994), and internalizing behavioral problems (Stevens & Prinstein, 2005; Van Zalk, Kerr, Branje, Stattin, & Meeus, 2010). Social information processing theory (Dodge, Bates, & Pettit, 1990) proposes that the behavior of children and adolescents is a function of the enactment of a sequence of steps in a cognitive processing system organized around the identification and interpretation of social cues (Crick & Dodge, 1994).

With this theory and research in mind, how might we expect social cognition to moderate the influence and selection processes in aggressive and prosocial behavior? To begin, children who tend to interpret ambiguous social cues as intentionally harmful, an indication of hostile attributional bias, are likely to be more reactive to the average levels of aggressive behavior around them, and in turn will more susceptible to adopt it (Brendgen, Bowen, Rondeau, & Vitaro, 1999). Building from research suggesting that children tend to make more hostile attributions about known aggressive peers than nonaggressive peers (Hubbard, Dodge, Cillessen, Coie, & Schwartz, 2001), this higher reactivity translates into two different scenarios according to the average peer behavior surrounding each participant. On one hand, for participants with high levels of hostile attributional bias who are surrounded by aggressive peers, we hypothesize they will be more likely to become more aggressive—and hence more similar to their peers (Grotpeter & Crick, 1996)—than participants with equally aggressive peers but low levels of hostile cognition. On the other hand, children with high levels of hostile attributional bias but encountering less ambiguous and aggressive provocations from their peers will be also more likely to adopt their peers' average behavior due to their hypothesized heightened reactivity to the context. Within this framework, a child's levels of attributional bias can be conceptualized as an intra-individual risk factor for participants who are likely to find aggressive or ambiguous interactions in their social group (De Castro, Veerman, Koops, Bosh, & Monshouwer, 2002; DeWall, Twenge, Gitter, & Baumeister, 2009), but as a potential protective factor for those participants who are exposed to low-aggression peer environments.

A similar moderating role can be hypothesized for the way in which hostile attributional bias may modify selection processes. Recent cross-sectional evidence indicates that children and adolescents tend to establish social ties with peers displaying similar levels of hostile attributional bias (Halligan & Philips, 2010), suggesting that the verbal and behavioral articulation of hostile perceptions may lead to social selection and segregation. Whereas this hypothesis is plausible, given the intra-individual nature of these attributional processes, it is likely that the correlations reported by Halligan and Philips (2010) are the result of an underlying preferential selection process that motivated participants to directly avoid aggressive peers, as a result of their tendency to attribute hostile intentions to their actions. As such, for this moderated selection effect, we hypothesize that participants with high levels of attributional biases will be less inclined to seek social ties with aggressive peers (Brendgen et al., 1999), demonstrating an effect of preferential selection.

Finally, although peer effects for prosocial behaviors are not completely understood, it is possible that prosocial cognitions (such as the individual tendency to imagine helping scenarios) could also act as a moderator of both processes in a similar way as hypothesized for hostile attributional bias and aggressive behavior. Thus, as one hypothesized moderator of preferential selection based on prosocial behavior, we postulate that participants with high levels of prosocial cognitions will be more inclined to actively seek ties with peers showing high levels of prosocial behavior, considering the behavior itself as a direct manifestation of their fantasized cognitive tendency (Rosenfeld et al., 1982). Similarly, as a potential moderator of prosocial influence, we hypothesize this cognitive tendency will render participants more susceptible to adopt the behavior of their peers. As such, for participants encountering a highly prosocial peer context, the tendency to imagine prosocial scenarios will increase the rate of adoption of their friends' average prosocial behavior (Brendgen et al., 1999; Rosenfeld et al., 1982). Similarly, for participants encountering a low prosocial context, the cognitive salience of prosocial behavior will less likely be stimulated by the environment and in consequence participants will tend to adjust to the average behavior of their peers over time.

THE PRESENT STUDY

We employ a stochastic actor-based method of social network analysis (Snijders et al., 2010; Steglich et al., 2010) to examine the effects of peer levels of antisocial and prosocial behavior on the co-evolution of social behavior and social networks in a population of elementary school students over a period of one academic year (Fall 2005 and Spring 2006). Consistent with prior work, we hypothesize both a selection and influence process in aggressive and prosocial behavior in this population.

After estimating these effects, we explore heterogeneity in their magnitude that is associated with individual social-cognitive processes. Specifically, we examine the extent to which peer selection and influence of aggressive behavior is moderated by individual levels of hostile attribution bias. We hypothesize that children reporting higher levels of this social-cognitive bias will be more likely to adopt the average aggression of their peers whenever a social relationship already exists (moderation of influence effect of aggression); however, they may also be less inclined to actively seek new relationships with peers already showing elevated levels of aggressive behavior (moderation of selection on aggression). Similarly, we explore the extent to which peer selection and influence on prosocial behavior is moderated by individual levels of prosocial cognitions. In this case, we hypothesize that youth reporting higher levels of this social-cognitive tendency will be more likely to be influenced by the prosocial behavior of their peers and to actively seek new relationships with peers with similar behavior.

METHOD

Participants

We employ data collected as part of the evaluation of the 4Rs (Reading, Writing, Respect, and Resolution) Program in New York City public elementary schools (Jones et al., 2011). The effects of this intervention on classroom-level and individual-level outcomes have been presented elsewhere (Brown, Jones, LaRusso, & Aber, 2010; Jones et al., 2010, 2011). In this article, we focus on change in social networks and social behavior in the second year of the study (Fall 2005 and Spring 2006, hereafter referred to as Time 1 and Time 2), during which all consented participants were in the 4th grade of elementary school. This segment of the data contains records for 900 students, nested in 74 classrooms across 18 schools. Time 1 was the first in this study to include a protocol for peer network data collection. The mean age of the participants at Time 1 is 8.62 years (SD = .69), 49.1% are male, 45.3% are Hispanic, 41.0% are African American, 9.1% are classified as members of other ethnicities, and 4.6% are non-Hispanic White. Calculated at the end of the academic year, the overall consent rate was 65.5% across schools (range = 44–79%; see Jones et al., 2010, 2011).

Procedures

Teachers and consented children completed questionnaires including measures of social behaviors and cognitions, demographic characteristics, and social networks 2 months after the beginning, and a month before the end of the academic year. Methods and procedures were approved by the Institutional Review Boards of the relevant universities during the period of data collection (New York University and Fordham University).

Measures

Social networks. Participants were asked to report about the interaction frequency of their peers (Gest, Moody, & Rulison, 2007) by identifying any pair of consented students who "hang around together a lot" in their classrooms (Cairns, Leung, Buchanan, & Cairns, 1995). From the report of each consented participant, we constructed a matrix, for each classroom, representing the number of times that pairs of students were perceived, by their peers, to "hang around together a lot." We further simplified the data by dichotomizing these counts, recoding the existence of a tie based on the agreement in the report of at least two consented members of the classroom. After these transformations, the resulting network of relationships at each of the two time points is represented in a matrix that is binary and symmetric (where a tie from i to j cannot be distinguished from a tie from j to i).

Given the undirected nature of these data, we proceed to our analysis with the assumption that changes in the social network of participants (creation or dissolution of social ties across time) are motivated, at each micro-step of the modeling process, by a single actor who unilaterally imposes his or her decision while being recognized by all other consented peers in the room.

To estimate our models, we grouped together the entire classroom-level matrices within each school, employing structural zeroes to indicate that participants were asked to nominate peers within their classrooms but not between classrooms within their school (see Ripley, Snijders, & Preciado, 2011 for methodological details). We use 18 school-wide matrices across two time points, in which each cell represents the existence of a social tie between each pair of actors from the perspective of the other participants in the classroom.

Social behavior. *Aggressive behavior.* Measured using the average response on 13 teacher-reported items collected with the Behavioral Assessment System for Children–II (Reynolds & Kamphaus, 1998). Teachers are asked to quantify, on a scale from 1 (*never*) to 4 (*almost always*), the frequency with which a particular student has, for example, "hit other children" or "called other children names" in the past 30 days ($\hat{\alpha}_{T1}$ = .96; $\hat{\alpha}_{T2}$ = .95). To satisfy the assumption of our model, we transformed this scale into a 7-category ordinal variable in which the bins are defined in 0.5 unit increments representing the frequency of aggressive behavior (see left panel of Figure S1 in the online supporting information).

Prosocial behavior. Measured using the Prosocial Behavior scale (Conduct Problems Prevention Research Group, 1999) and is the average response on 11 teacher-reported items ($\hat{\alpha}_{T1}$ = .95; $\hat{\alpha}_{T2}$ = .95). The instrument asks teachers to quantify the number of times a particular student is, for example, "*helpful to others*" or "*cooperates with peers*" in the past 30 days, on a scale from 1 (never) to 4 (almost always). Consistent with the aggressive behavior measure, we transformed this scale into a 7-category ordinal variable in which the bins are defined in 0.5 unit increments (see right panel of Figure S1 in the online supporting information).

Demographic and individual covariates and moderators. *Gender.* Represented with a binary variable coded as 1 for female and 0 for male.

Hostile attribution bias. Measured using participants' self-reports on an adaptation conducted by Jones et al. (2010) of the Home Interview Questionnaire (Dahlberg, Toal, Swahn, & Behrens, 2005). Six vignettes that depict ambiguous, but provocative social scenarios were read aloud while pictorial representations were presented (e.g., a student's milk carton is spilled on another student's back). Following presentation of each vignette, participants were asked to select four possible causal attributions regarding the intent of the provocateur. Two attributions refer to the provocateur's intent as benign or accidental (rated 0; e.g., the milk was spilled accidentally), and two refer to it as hostile or purposeful (rated 1; e.g., the student was being mean; $\hat{\alpha}_{T1}$ = .80). We included a dichotomous version of this scale at Time 1, recoding as 1 all cases where participants identified as hostile at least one of six items (n_1 = 369).

Prosocial cognitions. Measured using self-report on the *What I Think* instrument (Rosenfeld et al., 1982). The prosocial cognitions subscale contains six items that ask participants about the prosocial thoughts that just "pop into your head" (e.g., helping others, doing nice things for others). We included a dichotomous version of this scale at Time 1, recoding as 1 all cases where participants indicated to have at least one of these thoughts ($\hat{\alpha}_{T1}$ = .74, n_1 = 459).

Analytic Strategy

Using the R package of the Simulation Investigation for Empirical Network Analysis (SIENA) program (Version 1.2-212, Ripley et al., 2011), we model the co-evolution of networks and social behaviors in this population, as a result of processes at two nested levels. We follow the nomenclature introduced by Snijders and Baerveldt (2003) and refer to the within-school network evolution studies as the micro-level, and to the evaluation of central tendency and variability across these micro-level independent studies as the macro-level.

First, at the micro-level, within each of the participating schools, we explore the development of social relationships and behavior with the application of an actor-based network evolution model (Snijders, 2011; Snijders & Baerveldt, 2003; Snijders et al., 2010; Steglich et al., 2010; Veenstra, Dijkstra, Steglich, & Van Zalk, 2013). At this level, we estimate a taxonomy of models that include the effects described in Tables S1 and S2 (available in the online supporting information), under the assumption that changes in social networks are represented by micro-steps in which at a single moment, one actor has the opportunity to change one of his social ties, or to modify his social behavior. Given the undirected nature of our social networks, it is assumed that at each micro-step, one actor can impose a decision about a tie on the other actor, the other actor has to accept it, and this event is recognized by the rest of the peers reporting about their social ties.

Second, at the macro-level, we recognize that the estimates for each one of the effects at the school level can differ between schools. As such, following the procedures introduced by Snijders and Baerveldt (2003) and illustrated by Lubbers, Snijders, and Van Der Werf (2011), we combine the micro-level estimates in a way that takes into account the fact that differences between parameter estimates are composed of real variability and error (represented by the standard errors of the school-level estimates). Because these means and variances are the best estimates of the central tendency and heterogeneity of the population-level dynamics of network and behavior co-evolution, we present these aggregated results as our findings.

Finally, we evaluate the fit of our models to the data, with a generalized Neyman-Rao score test (Ripley et al., 2011; Schweinberger, 2011). For all our school-level networks, the addition of key parameters improves the fit when compared to a baseline specification (detailed results in Table S3 available in the online supporting information).

RESULTS

In Table 1, we present basic descriptive information about the time-variant and time-invariant characteristics of networks and behaviors in this population. The left panel includes information about the composition, structure, and change in number of social ties for school-level networks. The right panel presents descriptive statistics for the social behavior variables and other key individual covariates.

Time- and Gender-Related Differences

We explored basic associations between behavioral outcomes and predictors in the study with a set of Spearman's rank correlations, estimated separately by gender (see Table 2). As shown in Table 2, we observe a positive and statistically significant association between the two measurement points for each outcome for both genders, and negative, statistically significant associations between aggressive and prosocial behavior at each time point and across time for both genders. For girls, hostile attributional bias is positively associated with aggressive behavior at both time points and negatively associated with prosocial behavior. In contrast, for both boys and girls, prosocial cognitions are not associated with either outcome.

TABLE 1
Descriptive Statistics of Network and Behavioral Change for 18 School-Wide Networks Across Two Time Points

Network statistics	*Mean*	*Standard deviation*	*Behavioral statistics*	*Mean*	*Standard deviation*
Time-invariant attributes			*Time-invariant attributes*		
Size	50.00	18.35	Hostile attribution bias	0.41	0.34
% Female	49.1%	0.06	Prosocial social cognitions	0.51	0.38
Number of classrooms	4.44	0.92			
Time 1 (Fall 2005)			*Time 1 (Fall 2005)*		
Number of ties	109.28	58.07	Aggressive behavior	0.93	1.16
Density	0.09	0.03	Prosocial behavior	3.69	1.50
Degree	4.26	1.36			
Time 2 (Spring 2006)			*Time 2 (Spring 2006)*		
Number of ties	72.39	33.96	Aggressive behavior	1.10	1.23
Density	0.06	0.02	Prosocial behavior	3.72	1.50
Degree	2.89	0.76			
Network change			*Behavioral change*		
Hamming distance	215.56	104.59	Distance (aggressive behavior)	23.00	11.72
Jaccard index	0.26	0.09	Distance (prosocial behavior)	33.72	19.74
			% Stability (aggressive behavior)	0.49	0.13
			% Stability (prosocial behavior)	0.38	0.11

Note. Left panel presents school means and standard deviations for network statistics. Indices of network change (distance and Jaccard index) present a quantification of the amount of change across the school networks between the two time points. Right panel presents school means and standard deviations for individual behavioral and cognitive attributes. Indices of behavioral change (distance and % of stability) present a quantification of the average amount of change across individuals between the two time points.

TABLE 2
Spearman's Rank Correlations Between Primary Behavioral Dependent Variables and Individual-Level Covariates (N = 900)

	1	2	3	4	5	6
1. Aggressive behavior T1	—	.65***	−.58***	−.49***	.19***	.02
2. Aggressive behavior T2	.77***	—	−.55***	−.71***	.15***	.02
3. Prosocial behavior T1	−.66***	−.58***	—	.68***	−.10*	−.01
4. Prosocial behavior T2	−.59***	−.69***	.73***	—	−.10*	−.02
5. Hostile attribution bias T1	.05	−.02	.03	.06	—	−.07***
6. Prosocial cognitions T2	.04	.02	−.06	−.02	−.05	—

Note. Upper diagonal matrix presents results for girls (n = 442), lower diagonal matrix presents results for boys (n = 458).
*p < .05; **p < .01; ***p < .001.

Similarly, we detect statistically significant mean differences by gender in aggressive and prosocial behaviors at each time point. Girls are estimated at both time points to show lower levels of aggressive behavior than their male counterparts ($t_{T1} = 7.09$, $p < .001$; $t_{T2} = 6.99$, $p < .001$), while also showing higher levels of prosocial behavior than boys at both time points ($t_{T1} = -6.58$, $p < .001$; $t_{T2} = -7.71$, $p < .001$). Finally, we observe no gender differences in hostile attribution bias, but statistically significant differences in prosocial cognitions, indicating higher frequencies for girls ($t = -2.86$, $p = .004$).

Peer Selection and Socialization

In Table 3, we present the estimated aggregated results of a SIENA model (Model 1) in which we test our hypotheses about the selection and influence effects of peer aggressive and prosocial behavior. Along with this model, in Table 3, we present the results of a model evaluating the moderating role of social cognition in these estimated processes (Model 2).

In the first model presented in Table 3, we included all our hypothesized effects for network dynamics, along with basic parameters for aggressive and prosocial behavior. Of note, in this model are those parameters testing our selection and influence hypotheses for aggressive and prosocial behavior. According to this model, the estimated actor-based decisions to change ties are influenced, on average across the 18 participating schools, by the selective tendency to establish social ties (Est = −1.69, SE = 0.15), transitivity, or the tendency to establish social ties with common contacts (Est = 0.36, SE = 0.04), gender of the actors (Est = −0.27, SE = 0.08), and their tendency to establish ties with peers of their same gender (Est = 0.54, SE = 0.10). In this model, we do not detect statistically significant effects indicating that participants establish social ties with peers exhibiting similar levels of aggressive (Est = 0.18, SE = 0.23) and prosocial (Est = 0.11, SE = 0.23) behavior, after controlling for gender similarity and other structural effects influencing network dynamics.

In the behavioral dynamics portion of this model, we test the influence effect of peers' aggressive and prosocial behavior on individual levels of these behaviors. Here, we find a statistically significant effect (Est = 2.91, SE = 1.40, p = .03) for peers' aggressive behavior on individual-level aggression, even after controlling for the effect of prosocial behavior on aggressive behavior change, and for differences associated with the gender of the participants. Following the recommendations of Ripley et al. (2011), we transform and interpret this effect as estimated odds. As such, while holding all other parameters constant, we observe that participants are estimated to have 1.73 times the odds of changing their aggressive behavior in accordance with the average behavior of their social ties' than to not change it at all over the course of this academic year.

In this model, we also observe a positive but nonsignificant socialization effect of peers' prosocial behavior on individual prosocial behavior (Est = 1.40, SE = 0.91, p = .12). In this case, the statistically significant effect of gender and aggressive behavior on the dynamics of prosocial behavior change reduces the variability in the outcome and attenuates our estimate of the socialization effect of peers.

Social Cognitions as Moderators

In Table 3 (Model 2), we test the moderating effect of social cognition on the estimated preferential selection and influence processes for aggressive and prosocial behavior. Results indicate no statistically significant interaction effects of hostile attributional bias and selection based on the aggression of each participant's peers. When hostile attributional bias is included in the aggressive behavior dynamics portion of the model, we detect a statistically significant interaction with the average influence effect of peers' aggressive behavior on individual aggression ($\text{Est}_{\text{HAB} \times \text{Agg Influence}} = 3.48$, SE = 1.77, p = .04).

TABLE 3
Mean and Variance Components of 18 School-Level Models of Social Networks and Behavioral Change

	Model 1			*Model 2*		
	Mean	*SE*	*Variance*	*Mean*	*SE*	*Variance*
Network dynamics						
Rate parameter	5.44	0.48***	3.45†	4.97	0.41***	2.53
Density	−1.69	0.15***	0.38	−1.67	0.16***	0.44
Transitive triplets	0.36	0.04***	0.02	0.37	0.03***	0.02
Popularity (ego sqrt)	−0.07	0.07	0.08	−0.14	0.10	0.18
Female (ego)	−0.27	0.08***	0.11	−0.29	0.08***	0.18
Aggression	−0.03	0.08	0.11	−0.24	0.18	0.23
Prosocial behavior	−0.04	0.04	0.03	0.06	0.05	0.04
Hostile attribution bias (*HAB*)				0.03	0.06	0.06
Prosocial cognitions (*PSC*)				−0.12	0.08	0.11
Same gender	0.54	0.09***	0.14	0.50	0.11***	0.21
Aggression similarity	0.18	0.23	0.86	0.12	0.29	0.84
Prosocial similarity	0.11	0.23	0.88	−0.16	0.38	1.53
Aggression alter × HAB ego				−0.31	0.24	0.33†
Prosocial alter × PSC ego				−0.07	0.07	0.08
Behavioral dynamics aggression						
Linear shape	−0.08	0.09	0.32	−0.21	0.08**	0.08
Quadratic shape	−0.12	0.08	0.08	−0.04	0.07	0.07
Effect from female	−0.31	0.09***	0.11	−0.49	0.16**	0.32
Effect from prosocial behavior	−0.27	0.15	0.36	−0.20	0.09**	0.18
Aggression average influence	2.91	1.40*	3.29	3.37	1.30**	3.43
Effect from *HAB*				0.09	0.17	0.35†
Aggression average influence × *HAB*				3.48	1.77*	0.83
Behavioral dynamics prosocial behavior						
Linear shape	−0.12	~0.06	0.07	−0.18	0.07**	0.07
Quadratic shape	−0.13	0.03***	0.01	−0.15	0.03***	0.01
Effect from female	0.20	0.05***	0.04	0.33	0.07***	0.06
Effect from aggressive behavior	−0.28	0.09**	0.12	−0.19	0.05***	0.04
Prosocial average influence	1.40	0.91	3.49	1.67	0.97	3.08
Effect from *PSC*				0.02	0.08	0.08
Prosocial average influence × *PSC*				0.51	1.12	3.34†

Note. Statistical significance of the mean for each effect is evaluated with a *t*-test under the assumption of a standard normal distribution. Statistical significance of the variance for each effect is evaluated against a χ^2 distribution with $n-1$ degrees of freedom.
**p* < .05; ***p* < .01; ****p* < .001.
†At least 1 network excluded from the meta-analysis due to large standard errors (SE > 10).

We conducted a similar procedure to evaluate the potential moderating role of prosocial cognitions on the preferential selection and influence effects of prosocial behavior. In this case, we do not find statistical support for any of these moderated effects. However, after including these interactions in the prosocial behavior dynamics portion of the model (Model 2, Table 3), the magnitude of the previously reported nonsignificant socialization effect of peers' prosocial behavior increases slightly.

Heterogeneity of Results

Given that in our final fitted models we do not detect any variance component that significantly differs from zero, we are confident that our point estimates represent a good indicator of the central tendency of these dynamics in this population. Nonetheless, this evidence does not preclude the possibility of meaningful differences between classrooms and schools in the processes we are evaluating. To quantify potential sources of heterogeneity, we evaluated the degree to which classroom membership could have a significant effect in the average dynamics of networks and behaviors across our 18 participating schools. Results from this procedure (see Table S4, online supporting information) did not provide evidence suggesting statistically significant mean or variance effects of classroom membership in the network dynamics across the 18 schools in our sample, nor in the behavioral dynamics of aggression or prosocial behavior. Similarly, because the data for this article are drawn from an evaluation of a school-based social-emotional learning intervention, the presence of treatment at the school level could influence our results. As a check of the validity, we estimated our model exclusively for the control schools (n = 9), and do not detect any important differences in the magnitude or direction of our key effects while restricting the analytical sample (see Table S5, online supporting information).

DISCUSSION

Although multiple theories highlight the role of peers in the development of children and youth, only recently have the methodological tools been available to researchers to empirically estimate these effects. This research constitutes one attempt to isolate the unique contribution of peers on aggressive and prosocial behavior among elementary school students in an urban, high-risk context. Our results, obtained through the evaluation of an actor-based model for the co-evolution of networks and behavior across 18 elementary schools in New York City, suggest an important influence effect of peers on the aggressive behavior of children. We detect a statistically significant average effect of peer influence on aggressive behavior suggesting that children are 1.73 times more likely to change their aggressive behavior in accordance with that of their social ties than to not change it at all over the course of one academic year, while controlling for other parameters in the model.

We detect similarly sized effects for the influence effect of peers' prosociality on individual prosocial behavior, these effects are nonsignificant and constitute weaker evidence that individuals change their prosocial behavior in accordance with their closest peers. A comparison of these two estimated effects, obtained while controlling for different relational and demographic patterns that could explain the selection of individuals into particular peer constellations, suggests important differences in the salience of prosocial and aggressive behavior in the peer micro-context, as well as in the extent to which peers could exert an influence on the behavior of their social contacts.

To begin, it is possible that among this population, the behavioral display of aggression has achieved a particular salience that is not equivalently attained by prosocial behavior. The evidence does not indicate that participants are inclined to form new relationships with aggressive or prosocial peers (i.e., selection effect); however, it suggests that aggressive behavior could be implicitly perceived by actors as a behavioral pattern that is worth adopting (Farris & Felmlee, 2011; Molano, A., Jones, S.M., Brown, J., & Aber, J.L., in preparation) or is explicitly reinforced by peers (Dishion & Tipsord, 2011) to a greater degree than is prosocial behavior. This conclusion is partially supported by the work of Dishion and Tipsord (2011) suggesting that aggressive behavior in the peer context is frequently accompanied by peer reinforcements characterized by deviant stories, endorsement of deviant attitudes, and suggestions for subsequent deviant activities. While to our knowledge, equivalent evidence has not been documented for the reinforcement of prosocial behavior among peers, it is possible that acts of help and collaboration to resolve problems do not elicit the same type of support from peers, and in turn, may be perceived as less attractive for adoption by individual actors at this developmental period.

This notion finds some support in our second set of results, where we detect a statistically significant moderation effect of hostile attributional bias on the influence effect of peer aggression. These findings suggest that, for the portion of the population exhibiting higher tendencies to attribute hostile intentions to the behavior of their peers, even subtle signs of aggression are perceived explicitly or implicitly and evaluated as worthy of adoption, perhaps due to a combination of misattributions about their intrinsic value and perceived reinforcement from the social group. Among the portion of the population that accurately infers the intention of their peers' behavior (or, at a minimum, doesn't perceive it as hostile), the odds of socialization of aggressive behavior are lower, in this case, perhaps due to an explicit tendency to accurately identify episodes of aggression from neutral interactions. However, we do not find statistically significant evidence supporting the moderating role of social cognition in the strength and magnitude of peer influence effects of prosocial behavior, suggesting that aggressive and prosocial behavior have differential salience in the peer micro-context, but also highlighting that lower susceptibility to the aggressive influence of peers is not accompanied by higher tendencies to adopt other forms of social behavior.

Similarly, our decision to control for the cross-lagged effects of aggressive behavior on the dynamics of prosocial behavior (and vice-versa) provides some evidence about the multidimensionality of social behavior. Specifically, these results support a transactional view of social behavior, where aggression and prosocial behavior, net of their potential baseline differences associated with gender, are conceived as overlapping behavioral dimensions that could be enacted by the same individual (Dijkstra, Lindenberg, Verhulst, Ormel, & Veenstra, 2009; Veenstra et al., 2008), but that could be explained by different social processes. As such, our results suggest that when controlling for the effects of one form of social behavior on the other, participants are likely to adopt the aggression of their peers, but not their tendency to help or collaborate in solving problems.

LIMITATIONS AND FURTHER DIRECTIONS

Although we have strived to evaluate our hypotheses controlling for multiple plausible alternatives, this study has some limitations. First, it is possible that mechanisms and effects not included in our models drive our results and what appears as the tendency of peers to modify their aggressive behavior to conform to that of their classroom peers is in reality a by-product of other complex social dynamics. For example, it is possible that a larger portion of socialization of aggressive or prosocial behavior occurs outside school boundaries (Kiesner & Pastore, 2005) or in school settings not represented in our data (e.g., lunch rooms and playgrounds). Similarly, it is possible that other individual, developmental, dyadic, and classroom attributes could moderate and even mediate the process of selection and socialization of aggressive and prosocial behavior in this population. Although we have considered social cognition as a moderator, it is possible that these patterns of social information processing could act as an intra-individual mediator that translates the effect of peers into individual action (Van Zalk et al., 2010). Future research should evaluate this possibility while extending the analytical possibilities of current network models.

As an alternative strategy to reduce biases derived from omitted variables, further research could employ natural experiments resulting from policies and rules of classroom and school assignments that render social groups as equal in expectation at the elementary and middle school level (see Sacerdote, 2001). Alternative techniques developed in the econometric tradition could also be helpful when applied within a developmental science framework. For example, Bramoulle, Djebbari, and Fortin (2009) propose the use of instrumental variables estimation that capitalizes on the transitivity of school-based social networks to restrict the variability of social contacts' behavior to that which could be defensibly exogenous. Ali and Dwyer (2011) and Molano, A., Jones, S.M., Brown, J, and Aber, J.L. (in preparation) present an application of these analytical techniques to questions of adolescents' healthy and risky development.

A second limitation of our results is associated with our reliance on teachers as informants on the behavior of their students. Specifically, it is possible that our findings are the by-product of teacher's tendencies to overestimate the aggressive behavior of children who tend to "hang around" aggressive peers when compared to the prosocial behavior of children who tend to "hang around" prosocial peers. While our decision to statistically control for the effect of each one of these behaviors in the dynamics of the other reduces part of the variability in the outcome that is associated with the role of teachers as informants, from our current modeling strategy it is impossible to accurately identify the potential amount of reporter bias. Future research could compare our estimates to those obtained in equivalent populations where other informants are employed.

A third limitation of our results stems from the nature of our social network data, and the consent rates obtained for this research. As noted above, we use as indicators of the existence of a social tie between each pair of consented actors the perception and report of such tie by at least two consented classroom peers. While according to Gest, Farmer, Cairns, and Xie (2003) the concurrent validity of these types of reports and direct observations of the social interactions within classrooms is high, it is possible that the network dynamics represented in our data differ considerably from those that could be observed when including non-consented students as actors and reporters of the system. Similarly, restricting our network data to those nominations in which each student reports only about his or her social ties would, in theory, allow us to obtain directed, reciprocal, and nonreciprocal nominations. However, applying this constraint to our data, in which students were not required to include themselves in the groupings they identified, distorts considerably the overall structure of the classroom networks. We find that only 58.7% of the consented students nominated themselves as hanging around with other peers in their classrooms. Finally, in additional analyses, we have estimated that, on average, in classrooms in which less of the total number of available students consented to participate, the probability of obtaining extreme values in measures of density and transitivity is higher when compared to classrooms where most of the available participants consented to participate. These results, while not definitive, suggest that our findings are sensitive to the level of participation obtained in each classroom and as such, should not be considered as unbiased estimates of these dynamics in our population.

Similarly, our network data lack directionality in the perceived ties and hence do not allow us to estimate and control for independent effects of incoming and outgoing social relationships. While we have employed methods of estimation that adequately account for this feature, it is possible that our assumption about the creation of ties as imposed by a single actor does not adequately represent the dynamics of social network change in this population. Further research exploring other mechanisms of tie representation and formation, as described by Snijders (2011), could test the tenability of this assumption.

Finally, a strength of our research is that it explores these peer dynamics in a population of elementary school students in an urban, high-risk context. While previous research has suggested similar socialization effects of aggression across childhood and adolescence (Brechwald & Prinstein, 2011), to our knowledge this article is the first to explore equivalent processes on the dynamics of prosocial behavior and on the role of social cognitions. Further research could elucidate how changes associated with transitions across educational and social settings (Benner & Graham, 2009) and individual maturation (Card et al., 2008) are likely to modify our results.

Despite these limitations, this article constitutes an important addition to the literature on peer selection and socialization effects in educational contexts. With the current prevalence of theoretical conceptualizations of social relationships as systems of multiple nested layers, and the increasing use of social network analysis techniques, this article, and more broadly this special issue of the *Journal of Research on Adolescence*, adds importantly to the growing literature exploring the effect of social relationships on developmentally salient dimensions of child and adolescent well-being.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Table S1. Mathematical Representation and Description of the Included Effects, as Components of the Actor's Evaluation Function, for Modeling the Dynamics of Network Change Among 900 Early Adolescents in the City of New York.
Table S2. Mathematical Representation and Description of the Included Effects, as Components of the Actor's Evaluation Function, for Modeling the Role of Social Cognition on the Effect of Selection and Influence Effects of Prosocial and Aggressive Behavior.
Table S3. Goodness of Fit Evaluation.
Table S4. Mean and Variance Components of 18 School-Level Actor-Based Models for the Co-Evolution of Social Networks and Behavior Across Two Time Points in One Academic Year.
Table S5. Estimated Mean and Variance Components of School-Level Actor-Based Models for the Co-Evolution of Social Networks and Behavior Across Two Time Points in One Academic Year.
Figure S1. Observed Distributions of Aggressive and Prosocial Behavior for the Entire Sample (N = 900) Across Two Time Points.