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The Role of Sex of Peers and Gender-Typed Activities in Young Children's Peer Affiliative Networks: A Longitudinal Analysis of Selection and Influence

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Abstract

A stochastic actor-based model was used to investigate the origins of sex segregation by examining how similarity in sex and time spent in gender-typed activities affected affiliation network selection and how peers influenced children's (*N* = 292; *M* age = 4.3 years) activity involvement. Gender had powerful effects on interactions through direct and indirect pathways. Children selected playmates of the same-sex and with similar levels of gender-typed activities. Selection based on gender-typed activities partially mediated selection based on sex. Children influenced one another's engagement in gender-typed activities. When mechanisms producing sex segregation were compared, the largest contributor was selection based on sex; less was due to activity-based selection and peer influence. Implications for sex segregation and gender development are discussed.

Keywords

sex segregation; homophily; peer selection; peer influence; gender-typed activities; social networks

Children's tendency to interact with members of their own sex (i.e., sex homophily) is a ubiquitous pattern and leads them to spend much of their social time in sex-segregated groups. Sex segregation occurs in different cultures, ages, and settings (Maccoby, 1998), and although much has been written about the implications of sex segregation for children's development (Leaper, 1994; Maccoby, 1998), we have little understanding of its origins and the consequences.

A major question about the origins of sex segregation concerns the role of gender-typed activities. Interest in shared gender-typed activities (i.e., activity homophily) is one of the predominant explanations of sex segregation (Mehta & Strough, 2009) but few studies have tested this explanation. Also, questions have arisen about whether sex segregation emerges because children are attracted to peers who are interested in the same gender-typed activities, which then brings them into contact with same-sex peers, or are children simply attracted to same-sex peers (i.e., sex homophily) (Martin, Fabes, Hanish, Leonard, & Dinella, 2011). A related issue concerns the influence that peers have on children's

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engagement in activities. It is likely that children become more similar to their peers in their activity engagement over time. In addition to the direct consequences on children for engaging in particular activities (e.g., skill development), peer influence may indirectly amplify sex segregation. Specifically, as peers draw children into increasing engagement in gender-typed activities, they also bring them into increasing contact with same-sex peers.

Because there are several potential pathways to sex segregation, it is important to take a broad perspective on the processes involved in drawing children together. Specifically, we need to understand the bidirectional relation between activities and affiliation networks, that is, between children's selection into networks based on activities and the influence of peers on their activity engagement. The present study employed a short-term longitudinal design in which preschool children, their play-partners, and activities were observed several times a week over a school year. We addressed selection processes by asking whether children's choices of affiliation partners were affected by shared levels of interest in gender-typed activities when sex homophily was controlled, and we addressed influence processes by asking whether children's levels of engagement in gender-typed activities were affected by their playmates' engagement in these activities. To do so, we employed a stochastic actor-based model (SAB, otherwise known as SIENA, Snijders, van de Bunt, & Steglich, 2010) that jointly examines peer selection and influence processes.

Sex Segregation in Children

Sex segregation emerges early in life and by preschool, about half of children's interactions are with same-sex peers, about 30% involve mixed-sex groups (i.e., at least one boy and one girl), and less than 10% involve only other-sex peers (Fabes, Martin, & Hanish, 2003). Even though interest in other-sex peers increases in adolescence, same-sex preferences strongly persist through preadolescence and adulthood (Mehta & Strough, 2009, 2010).

Although levels of sex segregation vary across situations and time, young children exhibit moderately stable tendencies to engage in same-sex interactions (for review see Martin & Ruble, 2009). The strongest sex segregation is found when children have many interactional partners to choose from and activities are unstructured. In contrast, when partner choices are constrained or in situations structured by adults, peer interactions tend to involve more other-sex peers (Maccoby, 1990; Maccoby & Jacklin, 1987; Thorne, 1986).

Sex segregation has important consequences for development (Leaper, 1994; Maccoby, 1998). For instance, one view is that girls and boys develop within separate cultures, which provide different social experiences, styles of interactions, and opportunities for skill development. Because boys' interactions are rougher and more active (Di Pietro, 1981; Fabes et al., 2003), and because girls emphasize cooperation among play partners (Maccoby, 1990), exposure to these different behaviors and interaction styles is hypothesized to promote and strengthen gender differences in children. As a consequence of sex segregation, differences between the sexes become more pronounced (Maccoby, 1998). For this reason, it is important to address questions of how sex segregation begins and is maintained.

Explanations of Children's Sex Segregation

Several broad and related explanations have been proposed to account for children's sex segregation (Martin, Fabes, & Hanish, 2011). Some of these explanations directly link sex of partners to selection; however, most are indirect because they suggest that same-sex children being drawn together by experienced similarity on gender-typed characteristics rather than by sex of peers (Mehta & Strough, 2009). For instance, boys may be interested in playing with peers who like to play with cars (i.e., activity homophily) or who share similar play styles (Blaine & Blatchford, 2009), which likely results in increased interactions with other boys.

Direct explanations of sex segregation

Children may initiate and maintain contact with peers based simply on preferences for same-sex partners (Barbu, Le-Maner-Idrissi, & Jouanjean, 2000; Martin et al., 2011). When two people share the same category (i.e., sex), they are likely to attribute similar characteristics to group members because they assume they share an underlying essence (McPherson, Smith-Lovin, & Cook, 2001). Research has shown that children assume that same-sex peers are more similar to themselves than are other-sex children in preferences for novel toys (Martin, Eisenbud, & Rose, 1995). Given this tendency, children may expect that interacting with same-sex peers will be more enjoyable than interacting with other-sex peers (Maccoby, 1998; Martin et al., 2011) and this could promote sex segregation.

Indirect explanations of sex segregation

One of the broadest indirect explanations is based on evolutionary ideas concerning how early sex differences encourage segregation, which then facilitate later adult roles and reproductive success (e.g., Geary & Bjorklund, 2000; Pellegrini, 2004). From this perspective, sexual selection favors males who are larger and stronger because they have to compete for mates; and it favors females who are able to nurture, protect, and provision their offspring. Although children are not concerned with reproductive fitness when they segregate, they exhibit the behaviors associated with later fitness (e.g., boys are more competitive and physically active than girls; Pellegrini, 2004). These gender differences then draw children together around common goals and behaviors and provide children with practice in roles and skills that will enhance reproductive success later in life. There is some limited evidence to link individual differences in these fitness-related behaviors to peer preferences (Fabes, 1994; Martin et al., 2011; Pellegrini, Long, Roseth, Bohn, & Van Ryzin, 2007).

Children’s same-sex preferences also have been explained by behavioral compatibility, that is, children being drawn to other children who share similar interests and interaction styles. Because of sex differences in interests and activities, children with similar interests would likely be same-sex peers (e.g., La Freniere, Strayer, & Gauthier, 1984; Moller & Serbin, 1996). A range of behaviors is implicated in bringing children together including interaction styles, interests, activities, social behaviors, and communication patterns (Mehta & Strough, 2009). However, sharing interest in toys and activities is considered a particularly potent force for segregation for young children (La Freniere et al., 1984). Sex differences have been identified in children’s toy choices (e.g., boys prefer vehicles, male fantasy play; girls prefer dolls, female fantasy play) (Berenbaum, Martin, Hanish, Briggs, & Fabes, 2008). Thus, for young children, sex segregation may be a consequence of activity or toy preferences.

The behavioral compatibility hypothesis has been tested indirectly by examining similarity in the social behaviors of children who are friends or playmates. For example, Serbin and colleagues (Serbin, Moller, Gulko, Powlishta, & Colburne, 1994) found that children’s preferred interactional partners who shared similar characteristics to themselves but the reasons for these similarities were not addressed. Few studies have examined relations between behavioral similarity and sex-based preferences, and in some cases, no link has been found (Hoffman & Powlishta, 2001). Furthermore, the evidence concerning the role of activity similarity in sex segregation has been limited. The increases in children’s preferences for gender-typed activities and sex-segregation over early childhood suggest that these processes are related but direct links have not been clearly demonstrated (e.g., Serbin et al., 1994; Maccoby & Jacklin, 1987).

Although sex segregation is common in children, why it happens is not understood. Delineating which of several possible effects that activity similarity and sex similarity have in this process is an important goal. The indirect argument posits that because girls and boys differ in behaviors or activities, choosing playmates who prefer similar activities brings children of the same sex together, leading to sex-segregation. In other words, activity similarity mediates the effect of sex similarity on affiliation network selection. Alternatively, children may select peers based solely on their sex, in which case similarity in activities may be a spurious outcome. Another possibility is that both sex similarity and activity-based similarity independently contribute to selection. One challenge to parsing between these arguments has been distinguishing peer selection based on activities from peer selection based on peer sex, which has not been possible until recently. Another challenge is that peers may influence engagement in similar activities, making it important to separately assess selection and influence effects on activity engagement.

A third factor that may contribute to sex segregation is peer influence on gender-typed activities. Only a few studies have explored the socialization power of peers on gender-typed behaviors in early childhood (Ewing Lee & Troop-Gordon, 2011a, 2011b). Martin and Fabes (2001) found that girls' and boys' interactions in same-sex peer groups over the course of a few months in preschool contributed to changes in gender-typed activities, aggression, rough and tumble play, and play near adults, and these changes occurred above and beyond the individual difference variables that led children to initially select themselves into same-sex peer groups.

Although it has been proposed that activity differences between the sexes become more pronounced due to peer influences on activities, little is known about whether peer influence on gender-typed activity participation promotes sex segregation in early childhood. Prior research examining peer influence on children's activities has tested its contribution to the emergence of sex segregation. Thus, we explicitly examined the role of peer influences on gender-typed activities as another explanation for the origins of sex segregation. Assessing this contribution required testing for peer influence while simultaneously estimating the effects of peer selection based on sex and activity similarities.

The Current Study: The Co-Evolution of Networks and Gender-Typed Activities

The present study addressed both theoretical and methodological issues in understanding children's sex segregation. We assessed the viability of commonly offered explanations about why children select same-sex peers by exploring the extent to which direct (i.e., sex-based selection) and indirect (i.e., activity-based selection and socialization) processes contributed to sex segregation. We did this by using analytical methods that overcome methodological challenges typically associated with studying selection and influence processes.

In our theoretical model, children's behaviors are embedded in and influenced by their evolving social network. Sex homophily and gender-typed activity homophily are seen as complementary driving forces underlying the formation of young children's affiliative networks and play major roles in the emergence of sex segregation. That is, children use peers' sex to guide their choices of play partners, and they spend time with same-sex peers because they share interests in gender-typed activities. Once interactional ties are formed with same-sex peers, the process of social influence occurs, as children reinforce each other to exhibit similar levels of engagement in gender-typed activities. Peer influence may, therefore, amplify children's tendencies to segregate by sex. In this view, there is a mutual feedback loop between affiliative network structure and children's engagement in gender-typed activities.

Figure 1 depicts our hypotheses. This figure illustrates that, over time, children can change both their peer network (by adding or losing affiliation partners), and their behavior (i.e., level of engagement in gender-typed activities). Network selection processes orchestrating changes in affiliation partners are described by paths C, D, and E, while changes in activity engagement occur through paths A and B. Our first hypothesis is that children would select peer interactional partners based on sex similarity (i.e., same-sex peers, path D). Second, we expected that sex segregation would occur indirectly as boys and girls engage in gender-typed activities (path A) and select interaction partners based on similarity in activities (path C). To assess the extent to which selection based upon sex similarity could be explained by selection based upon gender-typed activity similarity, we conducted a mediational analysis. Third, we expected that children would influence one another's activity preferences (path B) such that children become more similar to their peers in levels of gender-typed activity engagement. This process could amplify sex segregation that originally emerged due to the other selection processes described above. An important unanswered question is the extent to which effects of sex on gender-typed activity participation could be explained by peer influences on activities. That is, by choosing to interact with same-sex peers, children are positioning themselves to be influenced to engage in more gender-typed activities. We explored this supposition through a mediational analysis. In sum, we examined the multiple pathways that link gender-typed activities to affiliative networks and can lead to sex segregation. As a final step, we also conducted a decomposition analysis that estimated the relative contributions of direct selection based on sex similarity and indirect effects through gender-typed activities to produce sex segregation.

Advantages of SAB Modeling

Our analysis relies upon a stochastic actor-based (SAB) model, which estimates changes in behavior (i.e., gender-type activity level) and networks (i.e., interaction partners) over time (Snijders, 2001, Snijders et al., 2010)· SAB models have been used to explore the co-evolution of adolescents' friendship networks and various behaviors in several studies (for a review see Veenstra & Steglich, 2011). Only one study has used a SAB model to explore networks of younger children, and that study focused on the structural aspects of their networks (Schaefer, Light, Fabes, Hanish, & Martin, 2010).

The SAB model is preferred over traditional methods of investigating selection and social influence processes because it overcomes the challenges inherent in estimating the hypothesized paths. The first challenge is estimating bidirectional effects. Children's social networks and behaviors co-evolve through selection and influence processes (Veenstra & Dijkstra, 2011; Veenstra & Steglich, 2011). This is evident in our model in paths B and C (see Figure 1). Because of the dynamic and interdependent nature of networks and behavior, both selection and influence must be accounted for in order to avoid biased estimates (Steglich, Snijders, & Pearson, 2010). Prior studies of behavioral homophily in young children have examined static snapshots of networks and behavior (Serbin et al., 1994; Maccoby & Jacklin, 1987). The question remains of whether similarities appear because children select similar friends, children become similar to their friends, or both of these processes occur. Because the SAB model simultaneously estimates changes in peer affiliation networks and behavior, it is capable of parsing between selection and influence. Thus, we explored whether peer influence on children's gender-typed activity engagement occurred net of selection based upon activity engagement, and vice versa.

The second challenge to understanding sex segregation is that multiple processes are responsible for the selection of interaction partners. The SAB approach explicitly models the probability of an interactional tie between children conditional upon multiple attributes of the children involved, including their similarity. This is in contrast to prior studies that aggregated children's peer interactions into the proportion of same-sex affiliations to describe sex segregation (e.g., La Freniere et al., 1984). In predicting which interaction ties exist, we include distinct effects of sex similarity and activity similarity. This approach also allowed us to test whether activity similarity mediated the effects of sex similarity on selecting an interaction partner.

The third challenge is controlling for alternative selection processes beyond sex and activity similarity. The SAB model allows control of other attributes upon which children may select their play partners (e.g. age and ethnic homophily). Just as important are structural network effects (path E of Figure 1), which capture the extent to which a connection between two children depends upon their relationships with other children (Veenstra & Steglich, 2011). For example, children are more likely to establish affiliations with friends of their friends through a process known as transitivity (Schaefer et al., 2010). These processes must be accounted for because they can magnify initially small levels of sex segregation. For instance, if only one child has a preference for same-sex friendships, that one child can foster sex segregation through transitivity by bringing his or her same-sex friends together. Failure to account for network effects results in inflated estimates of selection processes (Steglich et al., 2010).

The SAB model makes several assumptions that must be mentioned (see Snijders et al., 2010, for a detailed discussion). To begin, the SAB model assumes that ties and behavior change along a continuous time scale, even though the network may only be measured at discrete time points. Actors are assumed to change one tie or one behavior at a time. This precludes coordinated changes in the network or behavior. Presumably, such coordination is unlikely in our sample of preschool children observed during free play. Lastly, the model assumes that actors have the full knowledge of the network and other actors in it. Given that our observational data of children's peer interactions were collected in normative setting (i.e., classrooms), where all children got a chance to interact and thus know one another, this assumption is in line with our data. Additionally, previous research has shown that, even in early childhood, children are aware not only of gender groups but also hold stereotypes of gender-typed activities (see Ruble, Martin & Berenbaum, 2006).

In sum, we used SAB to examine the multiple pathways that link gender-typed activities to affiliative networks, which can lead to sex segregation. Additionally, we conducted a decomposition analysis that estimated the relative contributions of direct selection based on sex similarity and indirect effects through gender-typed activities to produce sex segregation.

Method

Participants

Participants were preschool-aged children enrolled in 18 Head Start classrooms. The children were involved in a cross-sequential longitudinal study in which they were observed extensively for a year during preschool, and then they participated in follow-up assessments for 2 additional years. Preschool classrooms were sampled in three cohorts over the first 3 years of the 5-year project. Children were recruited for participation 2 to 3 weeks into the start of the academic school year. Consent rates were 99% at recruitment (N= 308 out of a possible 311); 16 participants left the preschool and were not included in these analyses due to a low number of observations (fewer than 20 observations). There were no sex differences in children's rate of permission or attrition.

Of these 292 children (boys: *n* = 156, *M* age = 51.82 months, *SD* = 5.02, range 38-59) (girls: *n* = 136, *M* age = 51.04 months, *SD* = 5.61, range 37-60), 16 (8 boys) repeated preschool during years 2 and 3 of data collection and were retained in analyses to ensure that we had the complete networks in each classroom. This gave us an effective sample size of *N* = 308. The ratio of girls to boys per classroom ranged from 31-62% girls, and 85% of the teachers were female. The majority of children (69%) were Mexican or Mexican-American, 60% of the children primarily spoke Spanish. The remaining children were Anglo-American (8%), African-American (7%), Asian (2%), Native American (1%), and other or unknown (13%). Consistent with Head Start programs, children were from families of low socioeconomic status (82% earned below $30,000 per year). Almost half of the children (45%) came from two-parent married families.

Procedures and Observational Measures

Data were collected using a brief observation protocol (Martin & Fabes, 2001) in which children were observed indoors and outdoors during free-play (e.g., children freely decide what to do, with whom, and where to do it) in 10-second periods, multiple times a day, 2 to 3 times a week for several hours a day over the fall and spring semesters. Classroom observers (8-10 per year; 87% female) were intensively trained for the first 3-4 weeks of each semester. Training of observational coders consisted of several meetings to discuss the coding scheme, practice coding sessions and testing to insure coders knew the names of the children and all of the codes. For each day of coding, observers would begin at the top of a randomized list of children, complete the entire list, and then return to the top of the list again (approximately 3 to 6 times per day). Prior to recording data, observers noted whether the child was present and available for coding, present but unavailable for coding (e.g., in the bathroom), or absent. If present and available for coding, the observer would then record the child's identification number, the identification number of any peer play-partners (up to five), and the primary activity of the child (e.g., blocks). To be coded as an interaction with a peer, the focal child and the peer(s) had to either engage in a verbal or physical exchange during the 10-sec observation or engage in parallel play (both children playing in the same activity with no verbal or physical exchange). If the focal child was interacting with a teacher, peers were not coded, thus all teacher-child interactions were dropped from analyses.

Observers recorded children's play activity using a checklist of 26 mutually exclusive activities. A "miscellaneous activity" category was coded for low frequency activities (12 % of observations) and an "other" category was coded (e.g., talking, watching television, and snacking; 29.6 % of observations) to ensure that the list was exhaustive. These codes were dropped from analyses. The 26 play activities included typically masculine activities (e.g., balls), typically feminine activities (e.g., dress-up), and gender-neutral activities (e.g., clay, sensory activities). For two types of activities, figure play and pretend play, coders recorded if the play was masculine (e.g., action figures or playing superheroes), feminine (e.g., dolls or playing house), or neutral (e.g., unisex figures or pretending to be animals). The coders also recorded other features of interaction not used here (e.g., language spoken).

A total of 38,145 observations were collected for the children in this sample (*M* = 123.55 observations per child, *SD* = 58.95; range = 21-303; 89% with more than 100 observations). The number of observations recorded for each child varied due to differences in attendance and availability during coding. To determine reliability, two observers independently coded the same child's behavior or approximately one hour per week. Reliability assessments varied across coders to prevent bias in the time of day or activities for which reliabilities were conducted. Based on 2,714 simultaneous observations (7% of all free-play observations), kappas were calculated for each activity over the course of the year for each of the three years of data (6 semesters), and these ranged from .88 to .97 for feminine activities, .76 to .97 for masculine activities, and .82 to .97 for neutral activities. When data from all 6 semesters was combined, kappas were .87 for masculine activities, .92 for feminine activities, and .90 for neutral activities. For identification of peer partners, percent agreement across semesters ranged from .87 to .97. To control for the varying number of observations and presence in the classroom, we calculated *classroom presence*: the number of times a child was coded as present divided by the total number of observations attempted for that child.

Calculation of feminine, masculine, and neutral activity categories—To classify the 26 activities as feminine, masculine, or neutral, we tested for sex differences in each activity using independent-samples *t*-tests. To prevent a potential confound between play partner preferences and activity preferences with our sample, a different sample of children (N=103; *M* age = 48 months, 49% girls) from two university preschool classrooms and one Head Start classroom in the same urban southwestern city was used to determine gender-typed activity categories (using the same 26 activities). Participants in this sample were white (55%), Hispanic (19%), black (4%), Native American (7%), Asian, Pacific Islander, or Middle Eastern (13%), and other (2%).

Independent-samples *t*-tests resulted in six activities being categorized as feminine (crayons, dress-up, figure play feminine, music, pretend feminine, puzzles), *p*s < .05, six activities were categorized as masculine (balls, blocks, figure play masculine, large motor, pretend masculine, trucks), *p*s < .001, and 12 were categorized as neutral (books, clay, computers, digging, figure play neutral, kitchen, math and science activities, pretend neutral, sensory activities, phone, toy animals, and writing), all *ns.* Two of the 26 activities, bikes and board games, were dropped from further analyses because the results were not conclusive as they only showed trend levels of significance, *ps = .08, .10,* respectively. This categorization of activities is consistent with categories derived from other studies with similar samples (majority of participants were Mexican or Mexican-American) and methods (Goble, Martin, Hanish, & Fabes, in press).

Composite scores for each activity category (feminine, masculine, neutral) were created for each child by totaling the number of interactions in each play activity (e.g., crayons + books + music, etc.) in each category (e.g., feminine) and dividing by the total number of interactions in all 24 remaining activities. Thus, proportions indicated the percentage of activity-based interactions in which the child engaged in a particular category of activities (i.e., masculine, feminine, neutral).

For purposes of estimation, the proportion of observations each child spent in feminine and masculine activities was calculated for four waves and converted into an integer (as required by SIENA). For both activity types, a variable with five equal intervals was created: 0-20% = 1; 21-40% = 2; 41-60% = 3; 61-80% = 4; 81-100% = 5.

Network Measurement

Calculating network ties—We performed several steps to transform the observational data on children's interactions into networks representing which children "shared a tie." First, we calculated the numbers of times children were observed together. Frequency of interaction provides a reasonable proxy for young children's preferences in play-partners, because it is difficult to obtain a reliable report of friends from children at this age (Baines & Blatchford, 2009; Gest, Farmer, Cairns, & Xie, 2003; Schaefer et al., 2010). Because nearly all children interact with every other child in the class, only when children interact more often than expected by chance do their interactions likely represent an underlying relationship (Schaefer et al., 2010). In the present study, a tie between two children was coded as existing if the number of times two children were observed together exceeded what would be expected by chance for at least one of the children. By constructing ties in this manner, friendships across children can be asymmetric, but because these ties represent interactions between two children that are inherently symmetric, our final step was to symmetrize the network matrix. Symmetrized affiliation matrices have been previously used in ethological research (e.g., Santos, Vaughn, & Bost, 2008).

Calculating changes in the network over time—Observations taken throughout the school year were divided into four waves – two in the fall and two in the spring (split roughly in half). Network ties and activity participation were calculated separately within each wave. The Jaccard coefficient indicates stability in the network from one wave to the next by reporting the proportion of ties present at *either* time point that are present at *both* time points. The Jaccard coefficients for the present data ranged from .39 to .47 (Table 1). This level of stability affirms that the spacing of waves is appropriate for the analysis (Snijders, van de Bunt, & Steglich, 2010).

Calculating similarity as a measure of homophily—Dyadic similarity was measured differently depending on the nature of the attribute (i.e., dichotomous versus ordinal). For dichotomous measures of children's attributes, such as sex, homophily in a dyad was calculated as whether or not the two children were the same (coded 1) or different (coded 0). For ordinal measures of children's attributes, including age, activity participation, and classroom presence, homophily in a dyad was calculated as the absolute difference between the scores of the two children, which was then centered. Scores were then reverse-coded such that higher values represented greater similarity (for additional details, see Ripley, Snijders, & Preciado Lopez, 2011). Because one of our goals was to examine the contribution of sex similarity to affiliation ties, it was necessary to adjust for the sex composition of each classroom (e.g., La Freniere et al., 1984). Thus, we centered the sex similarity effect within each classroom by calculating the mean sex similarity that would be expected by chance (i.e., due to the classroom sex composition) and subtracting that mean from each dyad's similarity score.

Modeling Procedures

Model Overview—The SAB model estimates peer influence on behavior as well as the processes that produce ties between children (Snijders 2001; Snijders et al., 2010). Notably, behavior and ties are endogenous, meaning that the same behavior can be used as a criterion for tie selection and that its level can be influenced by one's ties. In estimating the model, we analyzed all 18 classroom networks simultaneously as a "meta-network" with the constraint that ties could only be between children in the same classroom (i.e., structural zeros prevented cross-classroom ties). Analyses were conducted using the *Rsiena* software package (Ripley et al., 2011).

Model Effects—The SAB model simultaneously considers two functions: one to estimate changes in the network (tie selection) and the second to estimate changes in behavior (e.g., through influence), which in the present case was activity participation. The network function models the likelihood of a tie between children by examining *effects of attribute similarity,* such as sex similarity (path D of Figure 1) and activity similarity (path C). For each attribute, the network function also includes the *effect of individual's attribute on degree* (i.e., having a tie), which represents whether children with certain characteristics are more likely to have ties. For instance, if children who engage in greater levels of genderstereotyped activities have more playmates, then the activity participation effect on degree will be positive.

We included controls for the following individual attributes that may affect tie selection: (a) ethnicity, (b) age, (c) percentage of time present in the classroom, and (d) repeating a year in the classroom. For each of these measures we included an *effect of attribute similarity* and an *effect of attribute on degree*.

The network function also controls for structural effects that facilitate ties (path E of Figure 1). We included the *transitive triads effect*, which captures tendencies toward triadic closure, whereby an individual's playmates also interact with one another (Hallinan, 1974). Thus, the transitive triads effect captures the likelihood that A has a tie to B, given that both A and B have ties to a third child C. This network process has previously been observed in affiliative networks of preschool-aged children (Schaefer et al., 2010). The network function also included effects for *degree*, which controls for the total number of ties in the network, and *rate*, which represents tie change opportunities.

The second component of the SAB model is the behavior function, which includes effects that are hypothesized to affect changes in activity participation. The dependent variable in this function is the level of gender-typed activity. Because we examined two types of behavior – feminine and masculine – our model has two behavior functions (with parallel effects in each). Predictors included children's characteristics, such as sex (path A of Figure 1), and the influence of peers on feminine and masculine activity participation (path B). For each activity type, we used the average activity participation of a child's playmates as a predictor of the child's own participation in the activity. If socialization was occurring, we would expect that the *average peer effect* would be positive and significant, meaning that a child changes his or her own behavior to become similar to his or her affiliative peers. Finally, estimating the behavior function requires additional effects that are not of substantive interest and only included as controls. The *linear shape* effect expresses the basic tendency towards higher or lower values of engagement in feminine and masculine activities, while the *quadratic shape* effect captures the feedback of behavior on itself. In combination, the linear and quadratic shape effects represent the distribution of each behavior. *Rate parameters* index the opportunities for change in the behavior at each period (i.e., between waves).

Results

Descriptive Results

Descriptive analyses over the four waves focused on (1) individual children and (2) the meta-network level (Table 1). For individual children, we present the mean number of ties per child and the averaged indices of proportion of time that boys and girls spend in masculine and feminine activities. Recall that activity means are based on integer coding of the proportion of time that children spend in respective activities, where 1 represents 0-20% of total activity time (i.e., feminine and masculine), 3 corresponds to 40-60%, and 5 to 80-100%. At wave 1, boys spent between 40% and 60% of their play-time in masculine activities and between 20% and 40% of time in feminine activities on average; girls were observed in both feminine and masculine activities, on average, between 20% and 40% of their total play-time.

At the meta-network level, we report the Jaccard index of tie stability, Moran's I index of homophily on gender-typed activities, and sex segregation odds ratios. The Jaccard coefficients indicate that from 39-47% of ties observed across two adjacent waves were present at both waves. Moran's I, which ranges from 0 to 1, is a measure of homophily that indicates whether children who share a tie are more similar in their activity preferences than would be expected if ties were random (Steglich et al., 2010). Higher values indicate stronger homophily (i.e., more similarity among play partners). These results indicate the presence of homophily on gender-typed activities that increased over time, especially for feminine activities. Because sex is a dichotomous measure, we use odds ratios to characterize sex segregation (Moody, 2001). Odds ratios were calculated as the odds of a same-sex tie (number of same-sex ties present divided by the number of same-sex ties absent) divided by the odds of a cross-sex tie (number of cross-sex ties present divided by the number of cross-sex ties absent). Odds ratios greater than 1 are indicative of sex segregation. As Table 1 shows, considered at the meta-network level, the odds of same-sex versus cross-sex ties increased from 3.66 in Wave 1 to 4.36 in Wave 4. Considered at the individual classroom level, odds ratios exceeded one in all 18 classrooms and across all waves, suggesting that sex segregation exists even when controlling for classroom sex composition (which determines how much sex segregation is to be expected by chance). We also calculated the more commonly-used percent of same-sex ties (La Freniere et al., 1984). On average, children interacted with a greater number of same-sex peers (i.e., the ranges were as follows: for wave 1, 55-76%, for wave 2, 56-78%, for wave 3, 57-85%, and for wave 4, 55-76%) but because this measure does not adjust for classroom sex composition, we report sex segregation using odds ratios.

SAB Results

In our analyses, we investigated two possible mediating effects. First, we proposed that activity similarity would mediate the effect of sex similarity on tie selection. Second, the effect of sex on activity engagement may be mediated by interaction with same-sex peers who are a source of influence. Although testing for mediation in network models has not advanced to the level seen with simpler linear models, by following the logic behind mediation (Baron & Kenny, 1986), our results offer some insight as to whether mediation may be occurring. Thus, we present a series of models that sequentially add effects for selection and influence on activity participation. We note how the coefficients for sex homophily and the effect of sex on activities change with the inclusion of activity selection and influence.

Baseline Model (Paths A, D, and E)—We begin our SAB analyses with a baseline model that estimates effects of sex and other individual attributes on tie selection (path D of Figure 1), while controlling for network effects (path E), and effects of sex on activity participation (path A). In this model, we examined whether boys and girls tended to (a) select same-sex play partners and (b) participate in different types of activities as a function of their sex.

Prior to considering the effects of substantive interest, we briefly review the significant results for the network effects (path E) and individual attributes (path D) on tie selection (these results have been omitted to simplify Table 2). The degree parameter was negative ($b = -0.43$, $p < .001$), indicating that the likelihood of any particular tie is low (i.e., most ties do not exist). The positive effect of transitive triads ($b = 0.08$, $p < .001$) documented that children tended to share mutual playmates. Turning to individual attributes, we found a positive race-ethnicity homophily effect suggesting that ties were more likely among children of the same ethnic background ($b = 0.18$, $p < .001$).

Addressing our first objective for this model, we examined the effects of sex on tie selection (path D of Figure 1; see Table 2). Sex was not a significant predictor of the number of ties indicating that boys and girls did not differ in the number of affiliation partners. However, the classroom-centered sex similarity effect was significant and positive ($b = .71$, $p < .001$). As expected, children were more likely to affiliate with same-sex peers than other-sex peers.

For feminine and masculine activities, the negative linear shape effects suggest that most preschoolers scored below the midpoint on these behaviors. In combination with the negative quadratic shape effects, this reveals a unimodal distribution of activity participation. We also examined the effect of sex on preschoolers' participation in gender-typed activities (path A; see Table 2). Not surprisingly, we found that girls were less likely than boys to engage in masculine activities ($b = -.45$, $p < .001$) and more likely than boys to engage in feminine activities ($b. = .77$, $p < .001$).

Selection Model (Paths A, C, D and E)—The next model estimated how network selection was predicted by participation in gender-typed activities (path C) in addition to the effects previously included in the baseline model (see Table 2). As expected, similarity on masculine ($b = .77$, $p =.008$) and feminine ($b = .62$, $p =.009$) activities significantly predicted the likelihood of affiliation ties. That is, when young children engaged in levels of masculine and feminine activities that were similar, they were more likely to affiliate with each other compared to when they participated in dissimilar levels of gender-typed activities.

This model provides insight to our question of whether similarity in activities with peers mediates the effect of sex similarity on affiliation. Establishing this sort of mediation requires four steps. First, we must demonstrate an overall effect of sex similarity on tie selection. This criterion was met by the significant effect of sex similarity in the baseline model. Second, we must demonstrate an association between sex similarity and activity similarity across all dyads in the network. To accomplish this, we estimated their correlation using a permutation approach developed for network data (QAP [quadratic assignment procedure], Krackhardt, 1987). Based on 1000 permutations conducted within each of 18 classrooms, the correlation was positive and statistically significant for feminine activities ($r = .28$, $p < .001$) and masculine activities ($r = .19$, $p < .001$), demonstrating that same-sex dyads tended to also be similar on activities. Third, we must find that the mediator (activity similarity) was a significant predictor of ties, net of the effect of sex similarity. This was observed in the current model. Finally, we must find that the magnitude of the sex similarity effect decreased once we added activity similarity to the model. The results of the current model indicated that the sex similarity effect dropped by 15%, from .71 to .60, but was still significant ($p < .001$). This pattern of results suggests that activity similarity only partially mediated the effect of sex similarity on affiliation.

Socialization Model (all Paths)—The third model tested for peer influence on children's activity participation, while controlling for tie selection based on sex similarity and activity similarity. To accomplish this, we added effects for peer socialization (path B) to the effects in the preceding model (see Table 2). We expected to find that peers influence the gender-typed activities of children, thereby helping to explain the effect of sex on activity preferences.

To begin, we found significant and positive effects of average peers' masculine ($b = .51$, $p < .001$) and feminine ($b = .68$, $p < .001$) activity participation on children's own engagement in these activities. Thus, children changed their levels of gender-typed activities to move in the same direction as their playmates. It is noteworthy that the effects for tie selection based on sex similarity and gender-typed activities similarity remained significant and positive in this model. Along with the sex and activity similarity effects, the peer influence results help explain the increasing similarity on gender-typed activities among children who shared ties (Moran's I from Table 1). These results suggest that peers played a significant role in influencing each other's propensities to engage in gender-typed activities, while controlling for the contributions of sex and activity similarity on tie selection.

We now consider whether peer influence may have mediated the effect of sex on activity engagement. We followed the same four-part strategy as above to test whether our results are consistent with mediation. The preceding model demonstrated the first step, that sex affects activity engagement. Second, we must show that sex similarity is associated with peer activity engagement. Our earlier mediation analysis demonstrated that sex similarity led to ties through similarity on gender-typed activities. Thus, children's sex led them to select peers with similar levels of gender-typed activities. Third, the current model showed that peers' activity engagement was predictive of children's own activity engagement while controlling for child's sex. Finally, when peer influence was added to the current model, the effect of sex dropped in magnitude by 13% for masculine activities (from −.45 to −.39) and 5% for feminine activities (from .77 to .73). These results are consistent with the pattern expected by partial mediation. Part of the reason sex is associated with gender-typed activities is that children select peers who influence their activity participation to be more gender typed. The relatively small decreases in the effects of sex suggest that peer influence is only part of the explanation for gender-typed activity preferences.

Decomposing the Contributions to Sex Segregation

As a final step, we conducted an additional analysis to determine the relative importance of several of the processes that could produce sex segregation. As shown in Figure 1, sex segregation can result directly from selection based on sex or indirectly through activity preferences, either of which may be amplified by network processes. Our results found support for all of these pathways; however they did not indicate the relative strength of each process in creating sex segregation. To identify the contribution of these various processes to sex segregation, we conducted a decomposition analysis based on the results of the Socialization model. The analysis involved estimating a series of nested models that systematically excluded the variable(s) of interest, then simulating networks with the given model parameters and measuring the odds of same-sex ties under each (see Steglich et al., 2010). This analysis essentially sets the coefficient for a path of interest to 0 and uses the model to simulate 1,000 networks (conditioned on the wave 1 network). The sex segregation odds ratios are averaged across simulations. A path contributes to sex segregation to the extent its absence from the model reduces the amount of sex segregation produced by the simulation.

We observed that the largest contributor to sex segregation was selection based directly on sex, which accounted for 57% of the observed sex segregation (see Figure 2). In contrast, activity-based selection and influence were responsible much less of the observed sex segregation. The remaining sex segregation was due to processes unrelated to sex or activities, changes in the rate of feminine and masculine activities (i.e., trend) or could not be attributed to just one of the aforementioned processes.

Discussion

The goals of this study were to investigate the origins of sex segregation by exploring selection and influence processes in young children's social network dynamics. Our objective was to better understand the roles of sex of peers and shared activities in drawing children together, and to better understand the ways children's interest in gender-typed activities might be influenced by spending time with their peers. Thus, we examined the processes of (a) selection based on sex similarity, (b) selection based on activity similarity, and (c) peer influence on activities in children's affiliation networks. We also determined the unique contributions of the direct and indirect explanations for the emergence of sex segregation in children's networks. To enable us to consider both selection and influence processes, we relied on the SAB model that simultaneously considered peer selection and influence processes over time.

The results are consistent with the theoretical model we proposed in which children's behaviors are embedded in and influenced by their evolving social network. In terms of selection, we found support for sex-homophily and activity-homophily as forces influencing the development of sex segregation. That is, we found evidence that children used peers' sex as an important guide in their choices of play partners. We also found evidence for the indirect explanation: children selected peers because they shared similar levels of interest in gender-typed activities. Once these interactional ties formed, the process of social influence occurred, as children reinforced each other to exhibit similar levels of engagement in gender-typed activities, thereby amplifying children's tendencies to segregate by sex. Overall, more variance in observed sex segregation was accounted for by selection based on sex of peers than by selection based on activities or on peer influence on activities.

Importance of Activity Similarity

Similarity on activities is one of the most common indirect explanations for young children's sex segregation (e.g., La Freniere et al., 1984). In the present study, we were able to discern that children who shared similar levels of gender-typed activities were more likely to develop ties over time. The finding that selection of peer interactional partners depends in part on shared activities may be the strongest empirical demonstration to date of the role of behavioral compatibility (in this case, activity compatibility) on sex segregation. Although behavioral compatibility theories have been proposed as explanations of sex segregation for many years (Goodenough, 1934; Moller & Serbin, 1996), evidence in support of this notion has been only indirect, usually in studies showing similarity on some characteristic in groups of children who are friends (Kindermann, 1993; Rubin, Lynch, Coplan, Rose-Krasnor, & Booth, 1994). Such similarity may have drawn children together, but it may also result from children socializing each other in their peer groups. For this reason, it is imperative to disentangle selection from socialization processes, but only recently have statistical approaches been developed that tackle this question effectively (Steglich et al., 2010).

Consistent with the behavioral compatibility hypotheses concerning gender-typed activities, the findings of the SAB model demonstrated that similarity on gender-typed activities provided a basis for peer affiliation even when several other selection processes were taken into account. Children were drawn to peers who engaged in similar levels of gender-typed activities as themselves, and we found evidence that this occurred above and beyond what can be explained by preference for same-sex play partners alone. Importantly, our mediational analysis demonstrated that despite the pivotal role that activity similarity has been given in explanations of sex segregation, this idea provided only a partial explanation of sex segregation.

Beyond Activity Similarity

Although activity similarity played a role in bringing children together in the present study, it did not fully account for the tendency to segregate by sex. Sex similarity continued to drive affiliation network selection even after consideration of activity similarity. Furthermore, when the roles of activity and sex similarity were compared in the decomposition analysis, both were found to play a role in sex segregation, but sex similarity played a larger role than did activity similarity. Children appeared to select same-sex peers as playmates for reasons beyond the activities in which they engage. This finding confirms that boys and girls tend to segregate even though they engage in similar activities (e.g., Maccoby & Jacklin, 1987).

Of course, same-sex preferences might also be accounted for by other types of gender-differentiated qualities on which children may show compatibility, such as behavioral qualities and interactional styles (e.g., activity level, rough and tumble play) (Fabes, 1994; Pellegrini, 2004). For instance, boys may enjoy interacting with other highly active children (likely to be boys) regardless of what toys they play with, and girls may enjoy interacting with other less active children (likely to be girls) regardless of whether they like to play with dolls or to play house. Individuals also may be drawn to others on the basis of more than one dimension of similarity. If alternate bases of attraction are related to gender but omitted from consideration when modeling tie selection, then the causal importance attributed to sex similarity will be inflated.

A significant methodological contribution of the present study included controlling for several important alternative dimensions of similarity (namely age and race) while examining the effects of activity and sex of child on selecting playmates. Furthermore, the SAB model includes consideration of network processes (e.g., transitivity), while examining selection effects. For researchers studying peer selection, the SAB model provides a way to test multiple dimensions of attraction while controlling for the fundamental network processes that confound investigation of selection effects. A useful next step would be to expand the model to include more fine-grained information on factors hypothesized to form the basis of behavioral compatibility.

Even then, explanations of sex segregation need to move beyond focusing on behavioral compatibility. Behavioral compatibility -- even across multiple dimensions of similarity -- is unlikely to fully account for the strength of sex-based homophily. Simply recognizing the categories of boys and girls provides a basis for peer preferences (Aboud & Mendelson, 1996; Bigler & Liben, 2007; Epstein, 1989). Knowing another child's sex provides children with information to define whether that child belongs to the in-group versus the out-group, and they form *expectations* about same-sex children sharing similar interests and that other-sex peers do not (Martin, 1994; Martin et al., 1995). Children use their expectations to decide which peers to approach and with whom they desire to maintain interactions (Barbu et al., 2000; Martin et al., 2011). Given that children's cognitions about gender and their experiences with peers develop more fully with age, we would expect that both likely contribute to the strength of sex-based homophily and its increase across childhood.

Peer Influence on Children's Activity Engagement

One primary interest was examination of socialization effects on activity participation. The present findings were consistent with ideas proposed by a number of writers that peers play important roles as socialization agents in children's lives (Harris, 1995; Leaper, 1994; Maccoby, 1998). Moreover, these effects were found with young children, indicating that peer processes are significant at early ages. Specifically, young children experienced gender socialization from peers: they became increasingly similar to their interactional partners in gender-typed activity engagement. As such, the present findings are consistent with one study examining gender socialization processes, in which children's behavior changed over time to become more gender-typed the more they interacted with same-sex peers over a few months (Martin & Fabes, 2001).

Future research on influence should consider the processes by which peers provide conformity pressures to move children's behavior closer to their own, and to explore changes in influence pressures over time. Another important topic that has yet to be fully addressed is whether same- and other-sex peers carry equal weight as socializers of behavior. Most attention has been given to same-sex peer socialization, but it is an open question whether other-sex peers also act as socializers of behavior, and the answer may depend on what qualities are being socialized. For instance, when Martin and Fabes (2001)

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explored socialization of gender-typed behaviors, these were found to be more effectively socialized by same-sex peers than by mixed-sex peer groups, but this could be due to the behaviors of interest. Furthermore, more consideration needs to be given to understanding why some children are susceptible to peer influence (Brechwald & Prinstein, 2011). Additionally, studies of influence have assumed that children move toward group norms but research needs to be broadened to explore how peer influence may move children away from group norms (e.g., Ewing Lee & Troop-Gordon, 2011a).

Socialization processes accounted for only some of the appeal of the sexes to engage in gender-typed activities in our mediational analyses. Even when socialization effects were taken into account, preschoolers continued to select activities that were gender-typed. A number of potential explanations exist for children's activity preferences including family processes, non-shared environmental influences, and the effects of hormones on behavior (Knafo, Iervolino, & Plomin, 2005). Future research efforts should be directed at exploring the stability and malleability of children's activity preferences based on differing social contexts.

Multiple Pathways of Gender Influence on Sex Segregation

The broader picture that emerges from our findings is that gender has a powerful effect on children's sex segregation through multiple pathways. First, segregation is promoted directly through children's tendencies to select same-sex interactional partners (path D in Figure 1). Tendencies for a child to be drawn to peers engaging in similar levels of gender-typed activities also promoted sex segregation since those peers likely were of the same-sex as the child (path A + C). Two reciprocal feedback loops contribute to segregation in more complex ways. The first feedback loop involves children becoming socialized by peers into gender-typed activities (path B), which then serve as a basis for subsequent friendship selection based on similar levels of gender-typed activities (path C). The second feedback loop through path E involves structural network processes that can amplify sex segregation. As a consequence of these complex processes, small preferences for sex homophily (path D) or small preferences for sex-typed activities (path A) can become magnified to produce high levels of sex segregation.

Because peer preferences represent such a large sex difference (sex accounts for 70-80% of the variance in play partner preferences vs. 1% to5% for most sex differences, Martin & Fabes, 2001), it is not surprising that researchers search for factors such as children holding strong own-sex preferences and bias against other-sex peers as accounting for this behavior. However, even widespread segregation can be accounted for by small effects that can lead to larger patterns. For instance, using simulations, Schelling (1971) found that neighborhoods could become highly segregated even when individuals held only small preferences for same race neighbors. Given that gender has been found in the present study to affect peer relationships both directly and indirectly, and that even small effects can be magnified as they play out over the group and over time, the magnitude of sex segregation may not be so surprising.

The present findings also are consistent with and relevant to the increasing sex segregation seen over the preschool year (Maccoby & Jacklin, 1987) and may provide an explanation for an interesting pattern that parents and researchers have noted: that as children enter group care settings, their tendencies to show gender-typed behavior increases. In addition to being exposed to more children, preschool often provides the first sustained opportunity for the multiple feedback loops of gender socialization to exert influence. Peer socialization into the separate cultures of boys and girls occurs when children have many opportunities to learn from and spend time with peers. In addition, these socialization experiences themselves further differentiate boys' and girls' interests, thereby increasing tendencies to segregate by sex.

Limitations and Conclusions

Some caution needs to be taken in generalizing from the present findings. The sample included a large number of Mexican-American children from low-income families; and, although the ethnicity effects were minimal, we were unable to assess the effects of other factors that might be associated with this particular sample (e.g., Head Start attendance). Including more measures of behavioral compatibility that are sex-differentiated would be useful for assessing whether children use multiple dimensions of similarity to select affiliation partners. Furthermore, with more females who volunteered to work on the project, we relied mainly on one sex of observers, which might lead to biased coding of behavior (e.g., Pellegrini et al., 2011).

Other external factors, such as neighborhood friends, siblings, or parents may also influence children's behavior but because we did not have access to this information, we could not control for other factors that may have encouraged gender-typical activities among playmates (or discouraged gender-atypical play), which could create patterns similar to peer influence. However, the fact that these results were based on 18 different classrooms, with 18 different external environments, provided some assurance that the findings represent evidence of peer influence. It seems unlikely that such external factors were consistent enough over time or across the classrooms to mimic peer influence.

Although the SAB model represents an advance over previous methods used to investigate sex segregation, it is not advanced enough to fully take advantage of our rich observational data. Thus, we invariably lost information as we transformed observations into discrete affiliation networks (e.g., information on the timing or sequence of interaction between children). SAB requires the use of categorical rather than continuous measures of endogenous behaviors, resulting in further information loss. Questions also remain about how to best identify ties between children using observational data. We defined a tie as existing when either child in a dyad was observed interacting with the other at a greater than chance level. This created symmetric, or reciprocated, ties between children. However, symmetry may not be ideal; unreciprocated ties may be more meaningful to study for some questions. For instance, consider a child who is infrequently in the classroom, but affiliates with one particular partner when she is present. The child is likely to be more strongly attached to her partner, and hence more susceptible to influence from her partner than vice versa. Such imbalanced, or nonreciprocated, ties were not investigated here, but may provide an avenue for understanding children's relative influence within dyads (Brechwald & Prinstein, 2011).

In summary, our longitudinal analysis provides a fuller description of sex segregation and gender socialization in young children. Gender played multiple roles in children's social networks. Gender played a direct role in that children selected to interact with peers based on their sex, and with peers who engaged in similar levels of gender-typed activities. Over time, children became more similar to their interactional partners in levels of engagement in gender-typed activities. The findings also indicated that gender had indirect roles in bringing children together through activities. The more time children spent with peers who engaged in similar levels of gender-typed activities, the more they were exposed to same-sex peers. By exploring the roles of sex and activity similarity as well as peer influence, we have outlined more clearly how sex segregation occurs in young children's social groups and the consequences of those play patterns.

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References

Aboud, FE.; Mendelson, MJ. Determinants of friendship selection and quality: developmental perspectives. In: Bukowski, WM.; Newcomb, AF.; Hartup, WH., editors. The company they keep. Cambridge University Press; New York: 1996. p. 87-112.

Baines E, Blatchford P. Sex differences in the structure and stability of children's playground social networks and their overlap with friendship relations. British Journal of Developmental Psychology. 2009; 27:743–760. doi:10.1348/026151008X371114. [PubMed: 19994579]

Barbu S, Le-Maner-Idrissi G, Jouanjean A. The emergence of gender segregation: Towards an integrative perspective. Current Psychology Letters: Behavior, Brain, and Cognition. 2000; 3:7–18.

Baron RM, Kenny DA. Th moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology. 1986; 51:1173–1182. doi:10.1037/0022-3514.51.6.1173. [PubMed: 3806354]

Berenbaum, SA.; Martin, CL.; Hanish, LD.; Briggs, PT.; Fabes, RA. Sex differences in children's play. In: Becker, JB.; Berkley, KJ.; Geary, N.; Hampson, E.; Herman, JP.; Young, EA., editors. Sex differences in the brain: from genes to behavior. Oxford University Press; Oxford: 2008. p. 275-290.

Bigler RS, Liben LS. Developmental intergroup theory: explaining and reducing children's social stereotyping and prejudice. Current Directions in Psychological Science. 2007; 16:162–166. doi: 10.1111/j.1467-8721.2007.00496.x.

Brechwald WA, Prinstein MJ. Beyond homophily: A decade of advances in understanding peer influence processes. Journal of Research on Adolescence. 2011; 21:166–179. doi:10.1111/j.1532-7795.2010.00721.x.

Di Pietro JA. Rough and tumble play: a function of gender. Developmental Psychology. 1981; 17:50–58.

Epstein, JL. The selection of friends: Changes across the grades and in different school environments. In: Berndt, T.; Ladd, G., editors. Peer relationships in child development. Wiley; New York: 1989. p. 138-187.

Ewing Lee EA, Troop-Gordon W. Peer processes and gender role development: Changes in gender atypicality related to negative peer treatment and children's friendships. Sex Roles. 2011a; 64:90–102. doi:10.1007/s11199-010-9883-2.

Ewing Lee EA, Troop-Gordon W. Peer socialization of masculinity and femininity: Differential effects of overt and relational forms of peer victimization. British Journal of Developmental Psychology. 2011b; 29:197–213. doi:10.1111/j.2044-835X.2010.02022.x. [PubMed: 21592148]

Fabes, RA. Physiological, emotional, and behavioral correlates of gender segregation. In: Leaper, C., editor. Childhood gender segregation: Causes and consequences. New directions for child development. Vol. 65. Jossey-Bass; San Francisco: 1994. p. 19-34.

Fabes RA, Martin CL, Hanish LD. Young children's play qualities in same-, other-, and mixed-sex peer groups. Child Development. 2003; 74:921–932. doi:10.1111/1467-8624.00576. [PubMed: 12795398]

Geary DC, Bjorklund DF. Evolutionary developmental psychology. Child Development. 2000; 71:57–65. doi:10.1111/1467-8624.00118. [PubMed: 10836558]

Gest SD, Farmer TW, Cairns BD, Xie H. Identifying children's peer social networks in school classrooms: links between peer reports and observed interactions. Social Development. 2003; 12:513–529. doi:10.1111/1467-9507.00246.

Goble PM, Martin CL, Hanish LD, Fabes RA. Children's gender-typed activity choices across social contexts. Sex Roles. in press.

Goodenough, F. Developmental psychology: an introduction to the study of human behavior. Appleton-Century; New York: 1934.

Hallinan MT. A structural model of sentiment relations. American Journal of Sociology. 1974; 80:364–378. doi:10.1086/225804.

Harris JR. Where is the child's environment? A group socialization theory of development. Psychological Review. 1995; 102:458–489. doi:10.1037//0033-295X.102.3.458.

Hoffman ML, Powlishta KK. Gender segregation in childhood: A test of the interaction style theory. Journal of Genetic Psychology. 2001; 162:298–313. [PubMed: 11678365]

Kindermann TA. Natural peer groups as contexts for individual development: The case of children's motivation in school. Developmental Psychology. 1993; 29:970–977. doi: 10.1037/0012-1649.29.6.970.

Knafo A, Iervolino AC, Plomin R. Masculine girls and feminine boys: Genetic and environmental contributions to atypical gender development in early childhood. Journal of Personality and Social Psychology. 2005; 88:400–412. [PubMed: 15841866]

La Freniere P, Strayer FF, Gauthier R. The emergence of same-sex affiliative preferences among preschool peers: A developmental/ethological perspective. Child Development. 1984; 55:1958–1965. doi:10.2307/1129942.

Leaper, C. Exploring the consequences of gender segregation on social relationships. In: Leaper, C., editor. Childhood gender segregation: causes and consequences. Jossey-Bass; San Francisco: 1994. p. 67-86.doi:10.1002/cd.23219946507

Maccoby EE. Gender and relationships: A developmental account. American Psychologist. 1990; 45:513–520. doi:10.1037//0003-066X.45.4.513. [PubMed: 2186679]

Maccoby, EE. The two sexes: Growing up apart, coming together. Belknap Press; Cambridge, MA: 1998.

Maccoby, EE.; Jacklin, CN. Gender segregation in childhood. In: Hayne, WR., editor. Advances in child development and behavior. Vol. 20. Academic Press, Inc; Orlando, FL, US: 1987. p. 239-287.

Martin, CL. Cognitive influences on the development and maintenance of gender segregation. In: Leaper, C., editor. Childhood gender segregation: Causes and consequences. New directions for child development, No. 65. Jossey-Bass Inc, Publishers; San Francisco, CA, US: 1994. p. 35-51.doi:10.1002/cd.23219946505

Martin CL, Eisenbud L, Rose H. Children's gender-based reasoning about toys. Child Development. 1995; 66:1453–1471. doi:10.2307/1131657. [PubMed: 7555224]

Martin CL, Fabes RA. The stability and consequences of young children's same-sex peer interactions. Developmental Psychology. 2001; 37:431–446. doi:10.1037//0012-1649.37.3.431. [PubMed: 11370917]

Martin, CL.; Fabes, RA.; Hanish, LD. Gender and temperament in young children's social play. In: Pellegrini, AD., editor. Handbook of Play. Oxford University Press; Oxford: 2011. p. 14-230.

Martin CL, Fabes RA, Hanish LD, Leonard S, Dinella L. Experienced and expected similarity to same-gender peers: Moving toward a comprehensive model of gender segregation. Sex Roles. 2011; 65:421–434. doi:10.1007/s11199-011-0029-y.

Martin CL, Ruble DN. Patterns of gender development. Annual Review of Psychology. 2009; 61:12.11–12.29.

McPherson M, Smith-Lovin L, M CJ. Birds of a feather: Homophily in social networks. Annual Review of Sociology. 2001; 27:415–444. doi:10.1146/annurev.soc.27.1.415.

Mehta CM, Strough J. Sex segregation in friendships and normative contexts across the life span. Developmental Review. 2009; 29:201–220. doi:10.1016/j.dr.2009.06.001.doi:10.1016/j.dr. 2009.06.001.

Mehta CM, Strough J. Gender segregation and gender-typing in adolescence. Sex Roles. 2010; 63:251–263. doi:10.1007/s11199-010-9780-8.

Moller LC, Serbin LA. Antecedents of toddler gender segregation: Cognitive consonance, gender-typed toy preferences and behavioral compatibility. Sex Roles. 1996; 35:445–460. doi:10.1007/BF01544131.

Moody J. Race, school integration, and friendship segregation in America. American Journal of Sociology. 2001; 107:679–716. doi:10.1086/338954.

Pellegrini AD. Sexual segregation in childhood: Review of evidence for two hypotheses. Animal Behavior. 2004; 68:435–443. doi:0.1016/j.anbehav.2003.07.023.

Pellegrini AD, Long JD, Roseth CJ, Bohn CM, Van Ryzin M. A short-term longitudinal study of preschoolers' (*Homo sapiens)* sex segregation: The role of physical activity, sex, and time. Journal of Comparative Psychology. 2007; 121:282–289. doi:0.1037/0735-7036.121.3.282. [PubMed: 17696654]

Ripley, RM.; Snijders, TAB.; Preciado Lopez, P. Manual for RSiena. University of Oxford; Department of Statistics, Nuffield College; 2011.

Rubin KH, Lynch D, Coplan R, Rose-Krasnor L, Booth CL. "Birds of a feather…": Behavioral concordances and preferential personal attraction in children. Child Development. 1994; 65:1778–1785. doi:0.2307/1131293. [PubMed: 7859554]

Ruble, DN.; Martin, CL.; Berenbaum, SA. Gender development. In: Eisenberg, N., editor. Handbook of Child Development. Wiley; New York: 2006. p. 858-932.

Santos AJ, Vaughn BE, Bost KK. Specifying social structures in preschool classrooms: Descriptive and functional distinctions between affiliative subgroups. Acta Ethologica. 2008; 11:101–113. doi:0.1007/s10211-008-0047-0.

Schaefer DR, Light JM, Fabes RA, Hanish LD, Martin CL. Fundamental principles of network formation among preschool children. Social Networks. 2010; 32:61–71. doi:10.1016/j.socnet.2009.04.003. [PubMed: 20161606]

Schelling TC. Dynamic models of segregation. Journal of Mathematical Sociology. 1971; 1:143–186. doi:0.1080/0022250X.1971.9989794.

Serbin, LA.; Moller, LC.; Gulko, J.; Powlishta, KK.; Colburne, KA. The emergence of gender segregation in toddler playgroups. In: Leaper, C., editor. Childhood gender segregation: Causes and consequences. New directions for child development, No. 65. Jossey-Bass Inc, Publishers; San Francisco, CA, US: 1994. p. 7-17.doi:0.1002/cd.23219946503

Snijders, TAB. The statistical evaluation of social network dynamics. In: Sobel, M.; Becker, M., editors. Sociological methodology. Basil Blackwell; Boston/London: 2001. p. 361-395.

Snijders TAB, van de Bunt G, Steglich CEG. Introduction to stochastic actor-based models for network dynamics. Social Networks. 2010; 32:44–60. doi:0.1016/j.socnet.2009.02.004.

Steglich, CEG.; Snijders, TAB.; Pearson, M. Dynamic networks and behavior: Separating selection from influence. In: Liao, T., editor. Sociological methodology. Boston/London: Basil Blackwell: 2010. p. 1-65.

Thorne, B. Girls and boys together, but mostly apart. In: Hartup, W.; Rubin, Z., editors. Relationship and development. Erlbaum; Hillsdale, NJ: 1986. p. 167-184.

Veenstra, R.; Dijkstra, JK. Transformations in adolescent peer networks. In: Laursen, B.; Collins, WA., editors. Relationship pathways: From adolescence to young adulthood. Sage; New York: 2011. p. 135-155.

Veenstra, R.; Steglich, CEG. Actor-based model for network and behavior dynamics: A tool to examine selection and influence processes. In: Laursen, B.; Little, TD.; Card, NA., editors. Handbook of Developmental Research Methods. Guilford; New York: 2011.

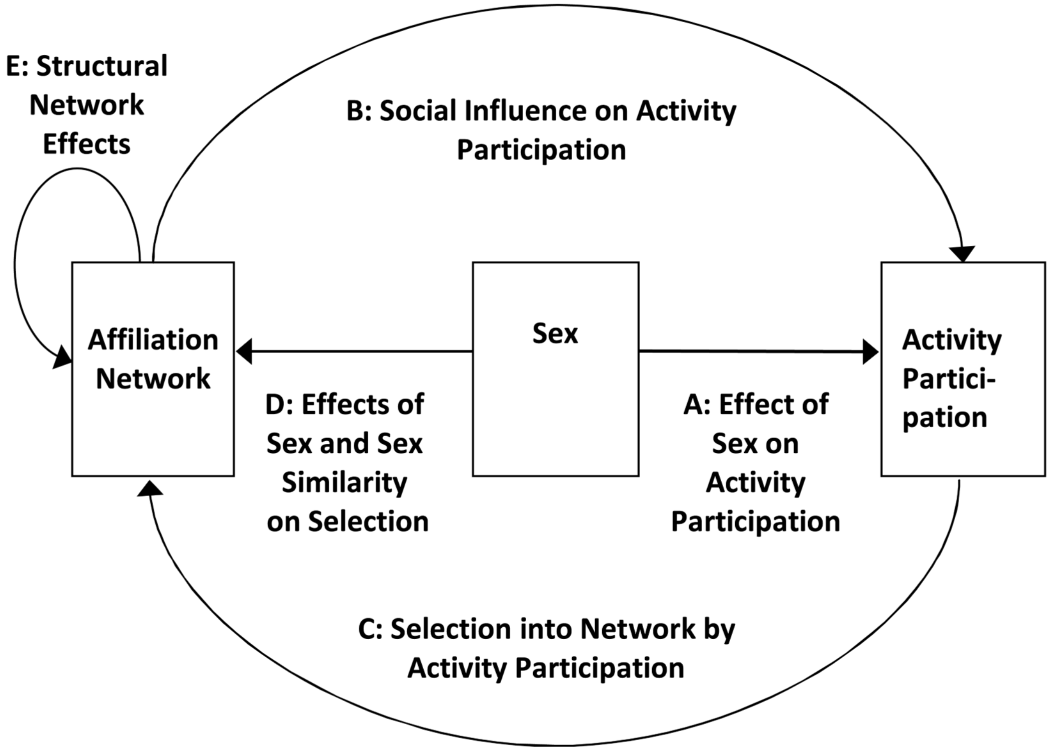

Figure 1.
Conceptual model of selection and socialization of behavior in peer network

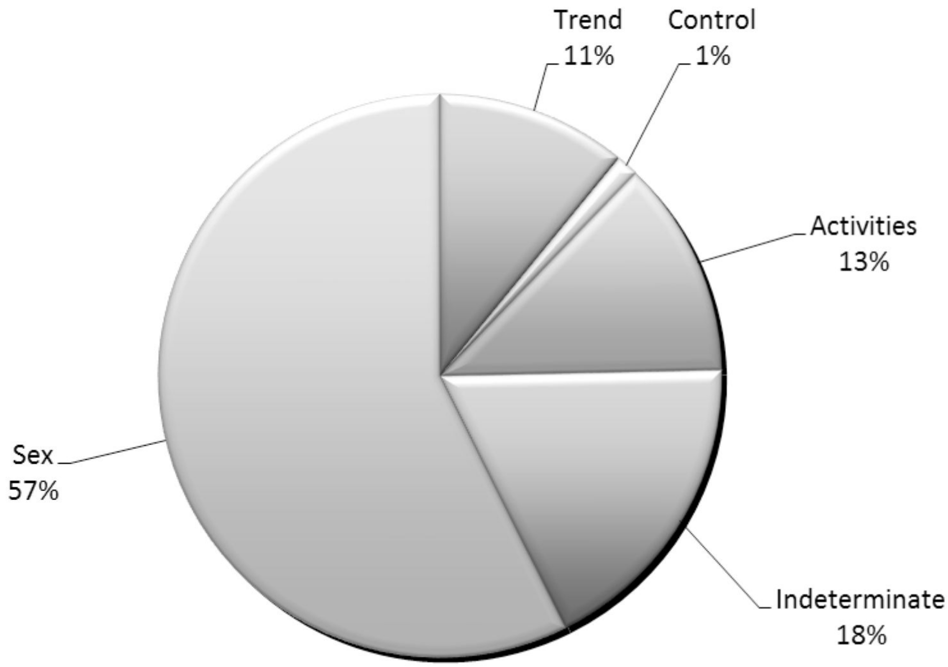

Figure 2.
Model-based decomposition of sex segregation: Contributions from various mechanisms.

Table 1

Descriptive Statistics

	Wave 1			Wave 2			Wave 3			Wave 4		
		M	***SD***		***M***	***SD***		***M***	***SD***		***M***	***SD***
Child Level												
Ties Per Child			6.56	(3.05)	6.77	(2.78)		6.48	(2.80)		6.01	(3.04)
Boys												
Masculine Activities		3.34	(1.14)		3.43	(1.33)		3.16	(1.08)		2.76	(1.11)
Feminine Activities		1.85	(0.93)		1.75	(0.92)		1.56	(0.65)		1.62	(0.82)
Girls												
Masculine Activities		2.31	(1.05)		2.36	(1.00)		2.02	(0.91)		1.75	(0.91)
Feminine Activities		2.90	(1.13)		2.94	(1.21)		2.90	(1.04)		2.88	(1.11)
Network Level [b]												
Number of children	283			301			282			272		
Jaccard Index [c]	-			.402			.387			.474		
Masculine Activity												
Homophily (Moran's I) [c]	.23			.21			.30			.30		
Feminine Activity												
Homophily (Moran's I) [c]	.22			.27			.33			.42		
Sex Segregation OR	3.66			3.24			4.32			4.36		
95% CI	[3.23, 4.14]			[2.87, 3.65]			[3.80, 4.92]			[3.81, 4.99]		

Notes. OR is Odds Ratio.

[a] Activity means are based on the integer coding of activity participation, which ranges from 1-5.

[b] Pooled across 18 classrooms.

[c] Index of network stability compared to prior wave, ranges from 0-1.

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Table 2

Coefficient Estimates and Standard Errors From SAB Analysis

	Baseline	Selection	Socialization
Parameters	**Estimate (SE)**	**Estimate (SE)**	**Estimate (SE)**
Network Dynamics			
Sex[a]	0.08 (0.05)	0.01 (0.08)	0.01 (0.08)
Sex similarity	0.71*** (0.04)	0.60*** (0.05)	0.57*** (0.05)
Masculine activities		0.01 (0.05)	0.02 (0.05)
Masculine activities similarity		0.77** (0.32)	1.02** (0.43)
Feminine activities		0.10+ (0.06)	0.09+ (0.06)
Feminine activities similarity		0.62** (0.26)	0.70* (0.31)
Activity Dynamics			
Masculine activities			
Linear effect	−0.15*** (0.03)	−0.15*** (0.03)	−0.13*** (0.02)
Quadratic effect	−0.08*** (0.02)	−0.08*** (0.02)	−0.17*** (0.03)
Effect from sex	−0.45*** (0.05)	−0.45*** (0.05)	−0.39*** (0.05)
Average peer effect (socialization)			0.51*** (0.06)
Feminine activities			
Linear effect	−0.29*** (0.04)	−0.29*** (0.04)	−0.27*** (0.03)
Quadratic effect	−0.11*** (0.03)	−0.11*** (0.03)	-0.25*** (0.04)
Effect from sex	0.77*** (0.08)	0.77*** (0.08)	0.73*** (0.08)
Average peer effect (socialization)			0.68*** (0.09)

Note. Standard errors are in parentheses.

*** $p < .001$

** $p < .01$

* $p < .05$

+ $p < .10$ (all two-tailed)

[a]Sex is coded as 1 = *girl*, 0 = *boy* (before centering). The following effects were estimated in the reported models but omitted from the table to improve readability: network and masculine and feminine activity rate parameters; degree, transitive triads; degree and similarity effects for age, race/ethnicity, classroom presence, and repeating a year in preschool.