Understanding Friendship Sex Heterophily and Relational Characteristics to Optimize the Selection of Peer Models for Children with Autism Spectrum Disorder

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Abstract

This study used social network analysis to evaluate whether sex heterophily, the degree to which peers are different in sex, between 126 children with autism (ages 5–12 years) and their peers affected social network connectivity. Results indicate that: (1) the quantity and sex of friends were more important in predicting social network connectivity than the relational characteristics of the friends (friendship nominations and social network salience/popularity); and (2) sex heterophily is an important factor in predicting social network connectivity. For males with autism, having friends of the same sex was associated with better social network connectivity; this was not true for females with autism. These findings have important implications for the selection of peer models for elementary-aged children with autism.

Keywords

Social networks; Autism; Peer relationships; Peer models; Schools; Sex

Introduction

Autism spectrum disorder (ASD) is characterized by deficits in social communication and the presence of repetitive and restricted behavior (APA 2013). The core deficits in social functioning such as social pragmatics (e.g., turn-taking in conversation, initiating

conversation, and the ability to take the listener's perspective), perseverative speech, and emotion regulation, expression, and understanding (Williams-White et al. 2007) may impede children with ASD from navigating social interactions, which in turn, may interfere with developing peer relationships (APA 2013; Locke et al. 2014). Research has shown differences in social functioning between children with ASD in comparison to their elementary school peers with regard to friendship reciprocity (Bauminger et al. 2010; Kasari et al. 2011); acceptance and inclusion in peer social networks (Rotheram-Fuller et al. 2010); and peer rejection (Locke et al. 2013). Although peer-mediated approaches are commonly used to support the social inclusion of children with ASD (Haring and Breen 1992; Sainato et al. 1992; Kamps et al. 1997; Pierce and Schreibman 1997; Laushey and Heflin 2000; McConnell 2002; Bellini et al. 2007; Kasari et al. 2012), little is known about what individual and relational characteristics of typically developing children make them optimal *peer models,* defined as typically developing peers who are paired with children with ASD to demonstrate appropriate behaviors (Utley et al. 1997; Zhang and Wheeler 2011; Kasari et al. 2012; Locke and Harker 2017), for these types of interventions. Understanding these factors may inform the identification and selection process of peer models and result in more meaningful and purposeful inclusion of children with ASD in general education settings.

Elementary-school teachers often select peer models based on logistical considerations and specific qualities of children (Locke and Harker 2017). Logistical considerations may include school attendance and academic performance to ensure that the peer will be available to participate in the intervention as well as capable of completing missed schoolwork or class time (Campbell and Marino 2009; Kamps et al. 2014; Newman and Murray 2005; Owen-DeSchryver et al. 2008; Renk and Phares 2004; Rodkin and Hodges 2003), whereas specific qualities of the peer often include obedience, self-confidence, mind-reading ability, leadership as well as popularity (Jackson and Campbell 2009; Locke et al. 2012; Kamps et al. 2014; Laghi et al. 2016). While these selection criteria address the feasibility of selecting peer models in schools, they do not account for the individual or relational characteristics between children with ASD and their peers that may lead to positive outcomes for children with ASD (e.g., friendship development and maintenance, inclusion) or prevent burnout for typically developing children. Peer models often experience additional demands, responsibilities, and pressures or feel obligated to help children with ASD, which results in burnout (Reiter and Vitani 2007). However, if peer models are selected because they are naturally connected with children with ASD or share a reciprocal relationship (Locke et al. 2012), serving as a peer model will feel less obligatory and may thereby reduce burnout. Garrison-Harrell et al. (1997) asked teachers to use peer social networks to understand the social position of children with ASD in relation to their classmates prior to peer model selection. This data-driven methodology may be more ecologically valid and appropriate for selecting peer models that may be a "better fit" for children with ASD.

Anderson et al. (2016) showed that sex plays an important role in predicting social network connectivity or inclusion in peer groups where females with ASD maintained more social stability when placed in larger classrooms, whereas the opposite effect was seen for males. These data suggest that the social networks of children with ASD may be sex dependent. Recent research also shows that ASD may present differently in males and females such that

males with ASD may have more overt behaviors and be more conspicuous among their peers, whereas females with ASD may be more camouflaged among or masked with their peers (Dean et al. 2014, 2017). This, in addition to previous studies of peer social networks of children with ASD and typical peer models (Locke et al. 2012; Garrison-Harrell et al. 1997), indicate that identification and selection of peer models should take into account children's sex.

Given that females may be more likely to be selected as peer models for males with ASD particularly in the younger grades (Chamberlain et al. 2007), and that children with ASD are more likely to be male (Blumberg et al. 2013), the purpose of this study was to evaluate whether sex *heterophily,* defined as the degree to which pairs of individuals who interact are different in certain attributes (Rogers 2003), between a child with ASD and his/her friends' sex affects their social network connectivity. This analysis is performed on classrooms where the social networks of children with ASD had evolved naturally; the "friendships" of children with ASD were not selected or facilitated by adults. To that end, our research questions were: (1) what characteristics predict the social network connectivity of children with ASD; and (2) how does sex heterophily, where friends are of the opposite sex, predict social network connectivity for males and females with ASD?

We characterized the friendships of children with ASD using a variety of factors such as the average number of friends the child has, grade, sex of the child with ASD, and social characteristics of their friends [i.e., the average number of friends that children with ASD have (received friendship nominations), the average number of friends they perceive they have (outward nominations), and the average popularity of their friends (social network salience)]. Additionally, we computed the heterophily score for each child with ASD, calculating the percent of friends of the opposite sex. These characteristics of the friends of children with ASD were used to predict the social status of children with ASD, to identify whether a specific "friend" profile may help socially anchor children with ASD to the rest of their class-room. Identifying the profiles of successful friendships could suggest how to optimally select peer models for children with ASD to maximize their social success in mainstream classrooms.

Methods

Participants

Data were drawn from three studies that examined the effects of a peer-mediated social engagement intervention of children with ASD in under resourced public schools around the United States (Kasari et al. 2012, 2016; Locke et al., in press). All children with baseline and exit data points who were enrolled in an active peer-mediated intervention (N = 126) were included in this study. Each classroom only had one child with autism. Data collection was performed throughout the school calendar year beginning in October, which allowed a minimum of 30 days into the school year for children to assimilate to their new classroom and peers. Missing data were handled by running parallel analyses where missing observations were removed and where missing values were imputed using median imputation, to ensure that these results were not dependent upon the data imputation strategy.

Inclusion criteria for children with ASD were: (1) an autism classification from a licensed professional and their school; (2) IQ of 65 or higher as measured by the Stanford-Binet-5 or Differential Ability Scale—2nd edition (see below); and (3) inclusion in a general education Kindergarten through fifth grade classroom for at least 51% of the school day. A total of 126 children from 126 classrooms in 49 schools participated. Children with ASD ranged in age between 5 and 12 years, with a mean age of 8.46 years (*SD* = 1.48) and an average IQ of 91.52 (*SD* = 14.92), wherever available (12.5% of classrooms were in school districts which prohibited the use of intelligence tests). Overall, 2% of the children were in kindergarten, 14% in first grade, 23% in second grade, 16% in third grade, 23% in fourth grade, and 23% in fifth grade. Males constituted 72% of the sample of children with ASD. The racial/ethnic backgrounds of the children were as follows for whom race/ethnicity was available (16.5% were missing or parents declined to specify): (1) race: 39% White, 25% African American, 16% Asian, and 4% Other; and (2) ethnicity: 17% Hispanic/Latino and 83% non-Hispanic/ Latino. See Table 1.

Measures

Friendship Survey (Cairns and Cairns 1994)—The Friendship Survey is a written measure that assesses children's peer relationships and social networks. The research team administered the Friendship Survey to all consented and assented children in a group format by classroom. Children were asked to identify classmates with whom they like to hang out with (i.e., friends) using free recall as no pictures or class lists were provided. The total number of classmates children could nominate was unrestricted. Children's *outward* (*out-degree*) and *received* (*in-degree*) friendship nominations were totaled from the number of nominations based on the question: "Are there any kids in your class that you like to hang out with? Who are they?" Additionally, sociometric data were gathered within each classroom to gain a robust picture of children's peer groups. Children were asked: "Are there kids in your class who like to hang out together? Who are they?" as a method of identifying specific children within each classroom social network. Children were instructed to think of all students in their classroom as well as students of both sexes. If needed, a member of the research team assisted children with reading or writing difficulty. The friendship survey has been reliably used with elementary-aged children with ASD (see Chamberlain et al. 2007; Rotheram-Fuller et al. 2010; Kasari et al. 2011, 2012; Locke et al. 2013; Anderson et al. 2016).

The social connectivity of children with ASD was measured by calculating *closeness,* which characterizes how closely connected a student is to all other students in the classroom. A student with high closeness has a shorter path to the rest of the children, while a student with low closeness is more distant socially than other children (Freeman 1979). This was calculated using the package *igraph* within R (Csardi and Nepusz 2006; R Core Development Team 2012), similar to the analyses conducted in Anderson et al. (2016).

Coding Social Network Salience (Cairns and Cairns 1994)—Social network centrality refers to the prominence of each individual in the overall classroom social structure. Following Cairns and Cairns (1994), a series of social network analyses were conducted from the Friendship Survey in order to obtain each student's social network

centrality. Three related scores were calculated in order to determine social network centrality: (1) the student's "individual centrality," the total number of nominations to any peer group within the classroom or individual popularity; and (2) the group's "cluster centrality," the average centrality or popularity of the peer group; and (3) the child's "social network centrality," or salience in the classroom. Using methods developed by Cairns and Cairns (1994), individual and cluster centrality were used to determine social network centrality. Based on categorizations by Farmer and Farmer (1996), four levels of social network centrality are possible: (1) isolated; (2) peripheral (connected to one or two classmates); (3) secondary (well connected and socially adept); and (4) nuclear (very 3 well connected and popular). Children who did not receive any peer nominations to a group were considered isolated. Children in the bottom 30% of the classroom were considered peripheral; children in the middle 40% of the classroom were considered secondary, and children in the top 30% of the classroom were considered nuclear (Cairns and Cairns 1994).

Procedure

The university Institutional Review Board as well as each school district approved the study. All ethical approval standards were met (see disclosure below). A member of the research team met with the principal at each prospective school to obtain a letter of agreement to participate in the study. Upon receipt, recruitment materials were distributed to the schools for interested families of children with ASD included for 51% or more of the school day. Families contacted the researchers to discuss their potential participation. Once informed consent was obtained, independent assessors administered the Autism Diagnostic Observation Schedule (ADOS; Lord et al. 2000) to confirm an ASD classification as well as a cognitive battery (i.e., the Stanford-Binet 5th Edition; SB-5; Roid 2003; or the Differential Ability Scale—2nd edition; DAS-II; Elliott 2007) to determine study eligibility. Subsequently, research personnel distributed consent forms to all children in the target child's classroom for participation in the Friendship Survey. After 40–50% of the classroom returned consent forms that permitted children's participation, children were given a written assent and a comprehension quiz to ensure their understanding of the study prior to administration of the Friendship Survey. The Friendship Survey was administered twice within the same school year: once before the intervention began and once immediately following the completion of the intervention, which lasted approximately 15–20 min per administration.

Data Analysis

Our primary analyses were performed on baseline observations prior to intervention implementation. At baseline, children's social connectivity (closeness) was predicted in a general linear model using properties of the classroom (grade, class size), properties of the child with ASD (sex, average number of friends), and properties of the friends of the child with ASD (salience, received friendship nominations were labeled "in-degree", outward friendship nominations were labeled "out-degree", heterophily). We tested whether heterophily, or the percentage of a child's friends of the opposite sex, affected a child's social connectivity and change in social connectivity by including it both as a main effect and an interaction effect with sex, thus testing whether heterophily is universally harmful, defined as a negative impact on children's relationships, or whether it may be harmful only

for male students. Heterophily was computed using the absolute differences between the child's sex (1 = male, 0 = female) and the percent of male friends the student had. For example, a male student with 30% male friends would have a heterophily score of .7, whereas a female student with 30% male friends would have a heterophily score of .3.

Because of sex imbalance in our sample (72% male), we replicated the main models using "Percent Male Friends" instead of "Heterophily." This tests directly whether the heterophily is driving the social connectivity or whether the heterophily effect is analogous to having more male friends. We additionally ran models separately within male and female ASD students.

Finally, we assessed what factors made a heterophilic friendship more likely. We predicted sex heterophily in a child's friendship choices in a general linear model, using the grade of the child with ASD, sex, classroom size, percent of male friends, and the social characteristics of the friends (salience, in-degree, out-degree, average number of friends). Collectively, this is an observational study of naturally selected typically developing peers, suggesting which covariates may be most important in maximizing a child's chance of social success.

Results

Research Question 1: What Characteristics Predict the Social Network Connectivity of Children with ASD?

Male Children with ASD and Social Connectivity—Children with ASD with more friends ($p < 0.01$) and male children with ASD ($p < 0.05$) had higher social connectivity. When male children with ASD were friends with females, however, their social connectivity was lower than for a comparable female, and the male child with ASD had reduced connectivity compared to a different male who was friends with more males ($p < 0.01$). This effect was not seen for females with ASD (Fig. 1). Holding constant sex and heterophily, children with ASD who were older ($p < 0.05$) and children with ASD who were in larger classrooms ($p < 0.05$) had poorer social connectivity (Table 2).

Female Children with ASD and Social Connectivity—Female children with ASD had greater social connectivity at baseline overall, but other factors influenced this such as grade, classroom size, heterophily, and the number of friends they had. See Fig. 2.

Research Question 2: How Does Sex Heterophily, Where Friends are of the Opposite Sex, Predict Social Network Connectivity for Males and Females with ASD?

Sex Heterophily—Children with ASD who had high sex heterophily were more likely to be males and were less likely to have male friends irrespective that there were more males with ASD in the sample (Table 3). This suggests that sex heterophily is more likely to affect males with ASD (Fig. 3). Social salience measures of the friends did not significantly predict whether a child experienced sex heterophily ($p < 0.10$).

Differences Between Males and Females with ASD—Because ASD may present differently in males and females (Dean et al. 2014, 2017), these models were replicated

separately within male and female children. When predicting baseline connectivity using only female children, only received friendship nominations were important ($p < 0.05$) such that receiving more friendship nominations increased social network connectivity; heterophily was not a statistically significant predictor of social network connectivity in female students with ASD. This was not due to the smaller sample size of females in this study since the intercept of heterophily for females was positive suggesting a possible benefit. When predicting connectivity using only male children with ASD, having more friends ($p < 0.01$) and having more popular friends ($p < 0.05$) was beneficial, while heterophily ($p < 0.01$) and grade ($p < 0.01$) were again detrimental.

Nonequivalence of Male Friends and Heterophily Variables—The sex heterophily variable was not a proxy for the percent of male friends a child had when conducting secondary analyses which analyzed social network connectivity using the percent of male friends instead of the heterophily variable. The percent of male friends was not statistically significant either as a primary effect or an interaction effect. This suggests that the sex heterophily explained the differences in social connectivity, and not the number of male friends.

Discussion

This study examined the characteristics of peers connected with children with ASD in relation to social network connectivity. The results of the study suggest that: (1) the quantity and sex of friends were more important in predicting social network connectivity than the relational characteristics of the friends (number of outward or inward friendship nominations and social network salience); and (2) sex heterophily is an important factor in predicting social network connectivity such that for males with ASD, having friends of the same sex was associated with better social network connectivity (this is not true for females with ASD). These findings do not discount the potential benefits and value that males with ASD may have with female peers as there may be qualitatively different conceptions of friendship among children with ASD (Petrina et al. 2014). However, these findings have important implications for the selection of peer models for elementary-aged children with ASD in schools.

For all children with ASD (especially males with ASD), there is a protective effect of being friends with male peers. In contrast to sex heterophily, the *theory of homophily,* which suggests that individuals have a tendency to choose friends and associate with others who have similar characteristics to them (Farmer and Farmer 1996; Kandel 1978), may offer one explanation for our findings. Children with ASD may connect with peers who are more similar to them (in this case, in terms of sex). In general, similarity allows individuals to establish an initial connection (Aboud and Mendelson 1996; Matheson et al. 2007), which may lead to the discovery of other similarities or common interests (shared interests, activities or games on the playground or in the classroom, etc., Laugeson et al. 2009). As these increase, the likelihood of being friends increases (Kupersmidt et al. 1995; Azad et al. 2016). These findings may have important implications for the selection of peer models included in peer-mediated interventions delivered in schools. In particular, researchers and school providers should consider enrolling male peer models to change the culture of the

context (e.g., classroom and the playground) for inclusion, particularly for male children with ASD as sex heterophily was worse for males as compared to females in terms of predicting social network connectivity. The current findings also may apply to informal strategies to support children with ASD such as classroom buddy systems or lunch bunches. School providers should be mindful of whom they select to be peer buddies as well as the composition of lunch bunch peer groups. Since children with ASD are more likely to be male (Blumberg et al. 2013), we also should examine the effects of sex in school-based peer-mediated interventions, which may help improve social network connectivity.

There may be several explanations for the observed sex heterophily in this study. Males with ASD with more significant social impairments may have selected female peers because females are more nurturing and often take on a maternal or "motherly" role (Chamberlain et al. 2007), whereas males with ASD who are more socially adept may be better able to make friends with other males. In addition, males may be more tolerant of social deficits associated with ASD in females as compared to fellow males, or that females with ASD may be able to "socially mask" their autism and befriend males more so than males with ASD (Dean et al. 2014). Alternatively, the heterophily effect may be reflective of a protective benefit seen in friendships with males, since females who were friends with males did not exhibit the same loss in social network connectivity. However, our data suggest that the sex heterophily of the child's peers explained the connectivity as opposed to the percent of male peers.

The benefit of any individual factor for connectivity (sex, grade, heterophily) is dependent upon the sex of the child with ASD. These findings are specific to children with ASD who are in elementary school, and may have important implications for the selection and identification of peer models based on relational characteristics. The social status of typically developing children may not be an important part of the selection criteria, as relational characteristics such as popularity/salience may not improve the connectivity of children with ASD. Research suggests that teachers and school personnel often nominate socially adept children to be peer models (Jackson and Campbell 2009). Rather than using popularity as a metric for selection, school personnel may want to carefully consider the *social positioning* of children with ASD relative to typically developing children prior to peer model selection to determine the best peer "fit" (Garrison-Harrell et al. 1997). The use of social positioning or social network inclusion as a selection strategy warrants systematic study and further research.

Limitations

While this study used novel analytical methods to identify what may comprise selection of optimal peer models for children with ASD, there were several limitations. First, our study may be underpowered to detect smaller effect sizes due to its sample size, and data such as IQ and ethnicity were missing at too high rates to estimate these effects. Second, longitudinal data that follow children with ASD into the following school year may be informative in predicting social network connectivity for two reasons: (1) relationships change as a function of time, and relationships at the end of the school year may be different than those at the beginning; and (2) relationships may naturally fragment or fade over the

summer months. Therefore, future research is warranted to understand the complex and dynamic nature of how friendships change among children with ASD over time. Third, the peers of children with ASD were naturally selected; however, in many peer-mediated interventions, peer models are intentionally matched, which may yield more stable relationships. This limits our ability to ascribe causation of heterophily to the poor social connectivity of males with ASD. Future studies should compare naturally selected versus intentionally matched peer models. Fourth, there may be sex differences in overt friendship behavior such that males may treat males with ASD more harshly than females with ASD, while females may be gentler towards children with ASD altogether that were not examined in this study and may change with age. Future research should qualitatively examine the nuances of friendship between and among males and females with ASD.

Conclusion

The selection of peer models is a critically important decision, as selecting appropriate and well-matched peer models may lead to improved outcomes for children with ASD (Locke et al. 2012). The purpose of this study was to examine the characteristics of peers (e.g., sex, number of friends, popularity of friends) who were connected with children with ASD to determine important factors that may point to optimal outcomes such as sustained social network connectivity. We found that the quantity and sex of friends and the sex heterophily were important factors in predicting social network connectivity over and above the relational characteristics of peers (i.e., popularity/salience). While these findings begin to unpack the characteristics of peer models who may support optimal outcomes in children with ASD, further research is needed in this area to advance our understanding and ultimately optimize the peer model selection process in schools.

Acknowledgments

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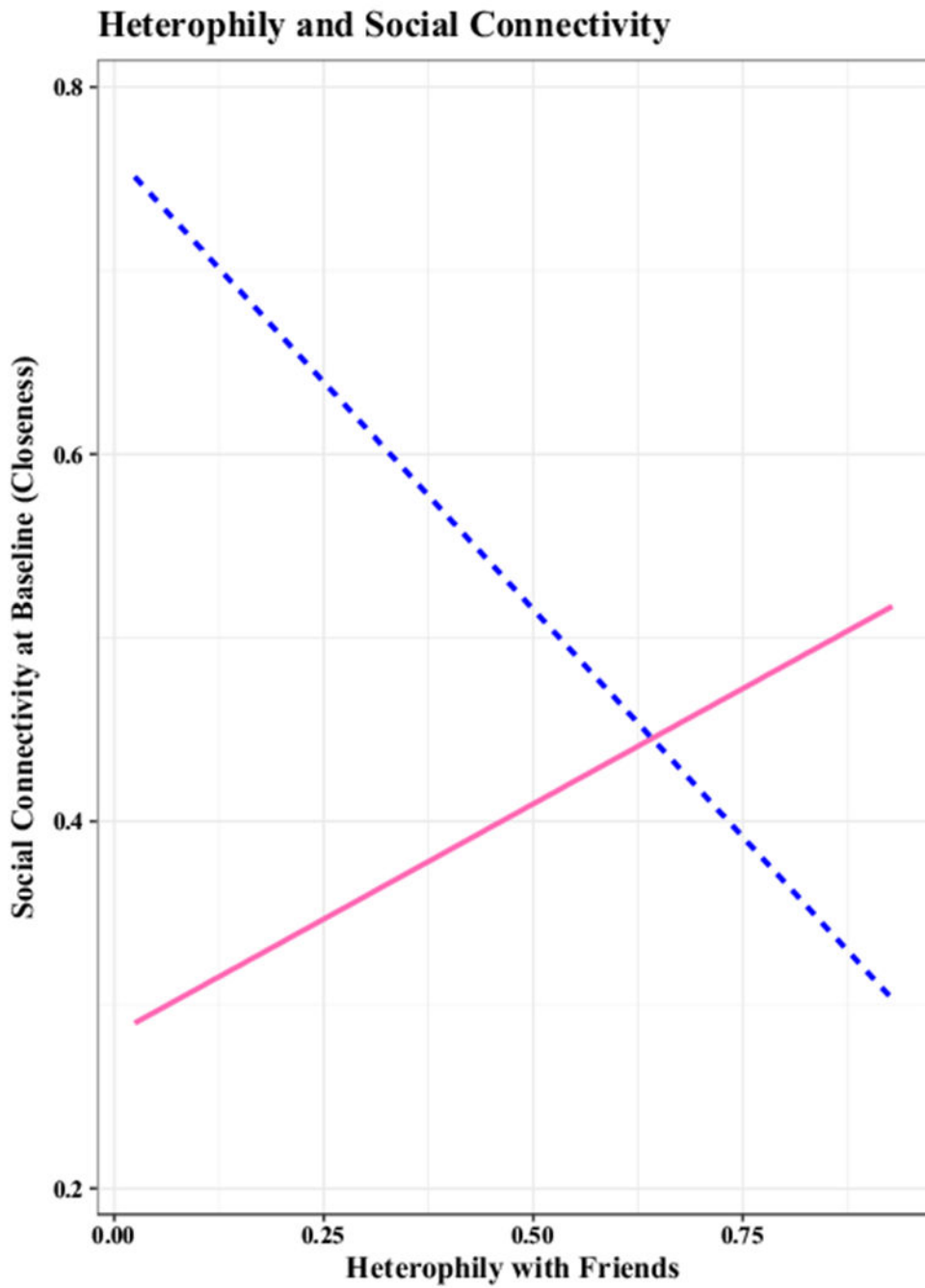
Fig. 1.
Males with ASD who had high sex heterophily, or who had more friends of the opposite sex, had poorer social connectivity as compared to females with ASD. This suggests that male friends are especially beneficial for male children with ASD for creating and maintaining social connectivity. Dashed line = Male, continuous line = Female

Fig. 2.
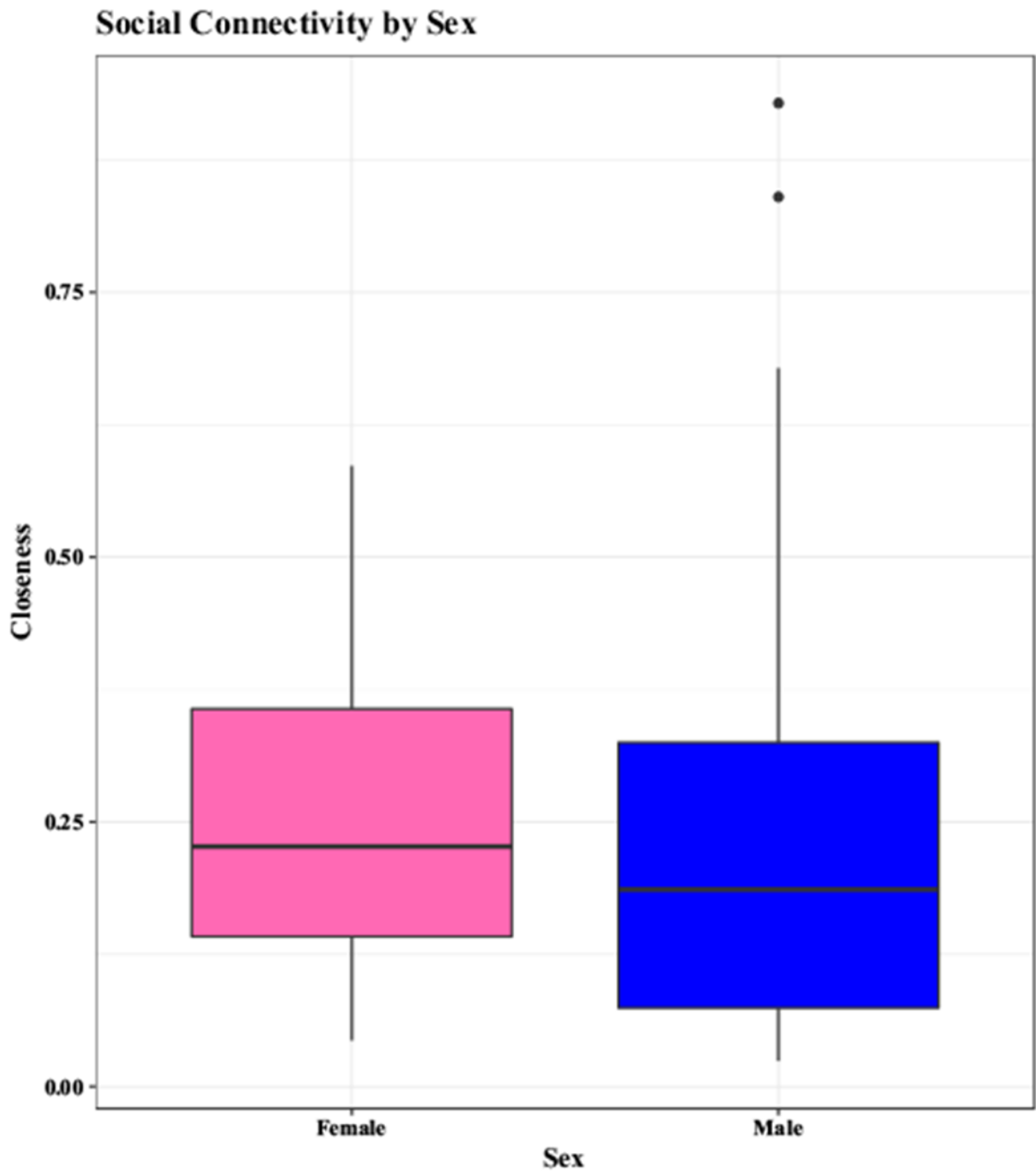At baseline, females with ASD had greater social connectivity than males with ASD. Group
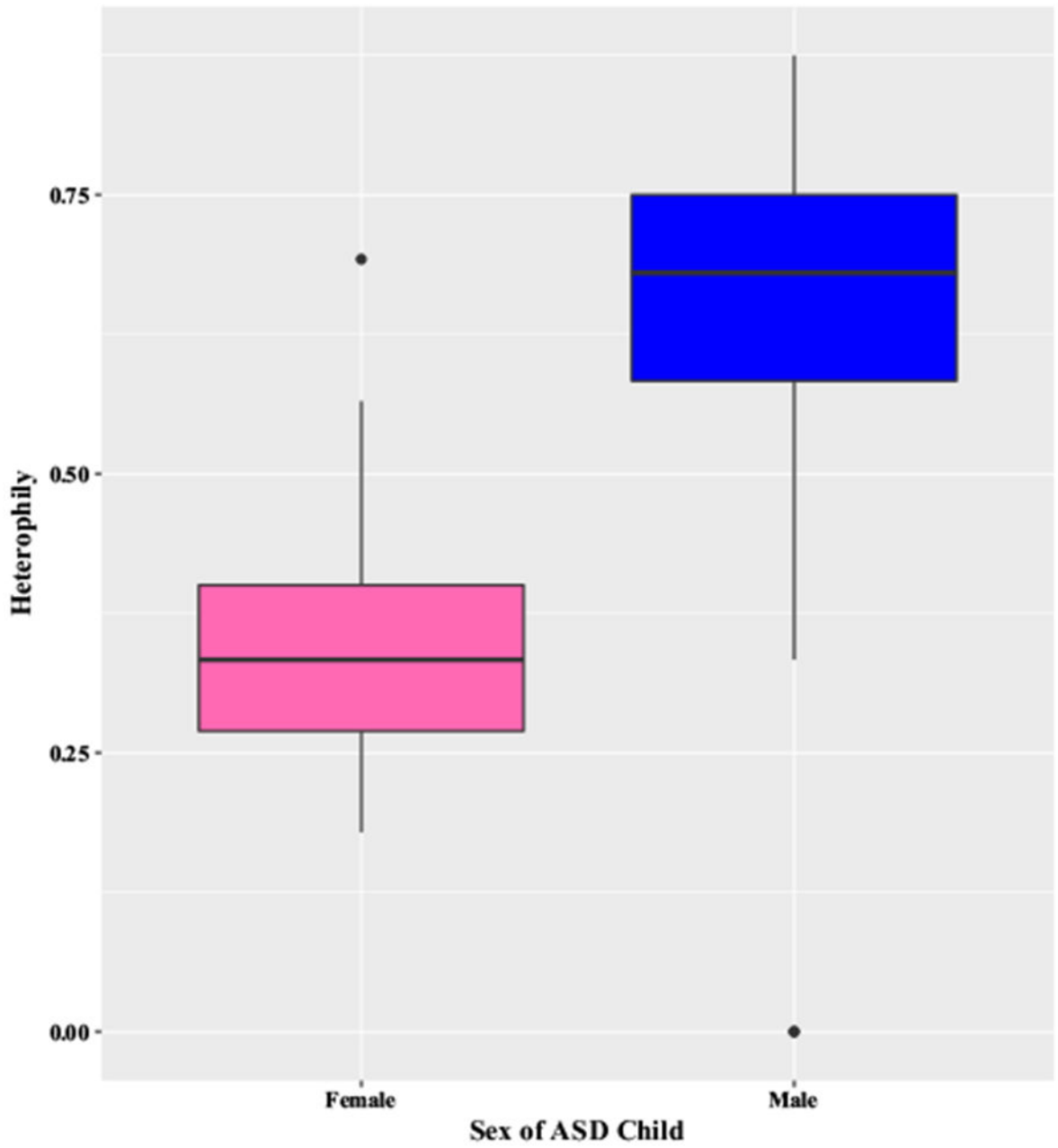0 = Female; Group 1 = Male

Fig. 3.
Males were significantly more likely to demonstrate friendship sex heterophily than females.
Group 0 = Female; Group 1 = Male

Table 1

Demographic information for children with ASD

Variable	Females				Males			
	Mean	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
Sample size (n)	35	–			91	–		
Social network salience at baseline	3.32	1.91	0	9	2.79	1.65	0	7.83
Outward friendship nominations at baseline	3.97	2.47	0	10	2.58	1.70	0	7.2
Received friendship nominations at baseline	2.07	1.69	0	6	2.02	1.72	0	10
Baseline closeness	0.25	0.15	0.04	0.59	0.23	0.20	0.02	0.93
Endpoint closeness	0.24	0.16	−0.39	1	0.23	0.18	−0.49	1.5
Classroom size	21.11	4.87	8	30	22.11	6.24	11	46
Age of child with ASD	8.46	1.32	6.41	10.69	8.47	1.54	5.23	11.43
IQ of child with ASD	93.97	15.55	70	150	90.49	14.64	67	127
Sex heterophily	0.35	0.11	0.18	0.69	0.65	0.15	0	0.88
Proportion of male friends	035	0.11	0.18	0.69	0.35	0.15	0.13	1
Average number of friends	2.66	2.42	0	12	2.82	3.18	0	17

Table 2

Social connectivity of children with ASD

Variable	Estimate	SE	t value	Pr(>|t|)	Significance
(Intercept)	0.32	0.12	2.67	0.01	**
Grade of child with ASD	−0.03	0.01	−2.40	0.02	*
Classroom size	−0.01	0.00	−2.13	0.04	*
Male sex of child with ASD	0.47	0.13	3.51	<0.001	***
Sex heterophily	0.38	0.22	1.76	0.08	
Average number of friends	0.02	0.01	2.80	0.01	**
Social network salience of friends (average)	0.01	0.01	0.89	0.38	
Number of outward nominations of friends (average)	0.01	0.01	1.47	0.15	
Number of received friendship nominations of friends (average)	0.02	0.01	1.98	0.05	
Male child with ASD: sex heterophily	−0.88	0.28	−3.09	<0.01	**

The social connectivity of children with ASD was higher for males with many friends, but this depended whether these friends were males or females. Heterophily, or having a greater percentage of friends of the opposite sex, was a risk factor for lowered social connectivity in males. For both sexes, children who were older or were in larger classrooms had reduced social connectivity

Signif. codes:

*** 0.001,

** 0.01,

* 0.05,

'.'0.1, ''1

Table 3

Children with ASD who had high sex heterophily had fewer male friends (p<0.01) and were more likely to be male (p<0.001)

Variable	Estimate	SE	t value	Pr(>|t|)	Significance
(Intercept)	0.49	0.12	4.21	0.00	***
Percent of friends who are male	−0.47	0.14	−3.27	0.00	**
Grade of child with ASD	0.01	0.01	0.74	0.46	
Classroom size	0.00	0.00	0.37	0.71	
Male sex of child with ASD	0.28	0.03	8.41	0.00	***
Average number of friends	−0.01	0.01	−1.92	0.06	
Social network salience of friends (average)	0.00	0.01	−0.24	0.81	
Number of outward friendship nominations of friends (average)	0.00	0.01	−0.17	0.87	
Number of received friendship nominations of friends (average)	0.00	0.01	0.06	0.95	