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Peer's pragmatic language outcomes following a peer-mediated intervention for children with autism: A randomised controlled trial

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Abstract

Background: Peer-mediated pragmatic language interventions can be of benefit to children with autism as they simultaneously target an individual child's pragmatic language skills and contextual factors related to social interactions. However, little is known about peer outcomes following peer-mediated interventions. **Aims:** This study evaluated the pragmatic language outcomes for typically-developing (TD) playmates who participated in a peer-mediated intervention for children with autism. **Methods:** Dyads (child with autism and TD-playmate; $n=71$) were randomised to a treatment-first or waitlisted-first comparison group. Dyads attended 10 clinic play-sessions with a therapist and parents mediated home-practice. The Pragmatics Observational Measure 2nd edition (POM-2), and Social Emotional Evaluation (SEE) evaluated pragmatics before, after and 3-months following the intervention. **Results:** Changes in both outcomes measures were equivalent for intervention-first and waitlisted TD-playmates, but all TD-playmates made significant gains in pragmatics following the intervention. Treatment effects maintained for 3-months ($p<0.001-0.014$, $d=0.22-0.63$), were equivalent in different environments (clinic and home). Peer relationship type and therapist profession mediated POM-2 scores across the study, while expressive language ability moderated SEE scores. **Conclusions:** This peer-mediated intervention had a positive impact on TD-playmate's pragmatic language capacity and performance.

What this paper adds?

The social challenges experienced by children with autism cannot solely be attributed to individual differences in social interaction skills, such as pragmatic language. The quality and quantity of social interactions with others can further compound the social challenges of children with autism. Peer-mediated intervention is one way to target children's pragmatic language difficulties while concurrently addressing the quality of social interaction through the

inclusion of a regular peer. However, little is known about the impact that participating in a peer-mediated intervention has on peers in the skill area they are expected to mediate. This study looked at the pragmatic language outcomes of typically-developing peers who participated in a peer-mediated intervention for children with autism. Results indicate there a significant improvement in TD-playmates' pragmatic language following participation in the intervention, and improvements made during the intervention period were maintained 3-months later. Findings suggest that attending a peer-mediated play-based intervention has no negative impact on the pragmatic language performance of the TD-playmates who participate. Friend-peers made greater gains in pragmatic language than sibling-peers, suggesting that the type and quality of relationship between children may be an important consideration for peer-mediated interventions in the future. Friend and siblings relationship quality may also have an impact on children's conversation and socioemotional development.

Keywords: social communication, video-modelling, intervention development, school-age, autism

1.0 Introduction

Pragmatic language difficulties have been linked to behavioural and emotional problems and impaired social functioning in childhood (St Clair, Pickles, Durkin, & Conti-Ramsden, 2011). This study adopts a definition of pragmatic language that recognises the evidence of an interconnection between language and socioemotional skills (Fujiki, Brinton, & Clarke, 2002). Pragmatic language therefore includes behaviour that incorporates the social, emotional and communicative aspects of social language (Adams, Baxendale, Lloyd, & Aldred, 2005).

Difficulties with pragmatics are a common feature in the communication profile of children with autism (Helland & Helland, 2017), and span across communicative and socioemotional aspects of social interaction. For example, children with autism attempt fewer initiations than typically-developed children, and have difficulty judging how much language to use in conversational responses, expressing emotions, taking another's perspective during conversation, and interpreting and responding to the emotions of others (Begeer, Koot, Rieffe, Terwogt, & Stegge, 2008; Paul, Orlovski, Marcinko, & Volkmar, 2009). In combination, these pragmatic language difficulties can adversely affect social experiences of children with autism.

However, the social difficulties experienced by children with autism cannot be solely attributed to individual differences in social interaction skills. The quality and quantity of social interactions with others are contextual factors that also influence the social functioning of children with autism (Sasson et al., 2017). This notion is supported by The *International Classification of Functioning, Disability and Health* (ICF), which conceptualises a person's functioning as an interaction between their health condition and contextual factors (World Health Organization, 2001). If the ultimate aim of pragmatic language interventions for children with autism is to enhance every-day social interactions, then interventions should not

just target the pragmatic skills of children with autism; they should also target the skills of the people with whom the children are interacting.

Peer-mediated interventions are well suited as a means of targeting an individual child's pragmatic language skills in conjunction with aspects of their regular social-contexts (e.g., a peers' own social interaction skills, a peer's ability to support the social interactions of a child with autism). Peers can be a conduit to improved pragmatic language as they model and reinforce positive social interactions (DiSalvo & Oswald, 2002). As the recipients of these improved skills, a peer's motivation to initiate and continue social interactions with the child with autism can be increased, thus expanding the social interaction opportunities for the child with autism (DiSalvo & Oswald, 2002). With increased opportunities for social interaction, children with autism are likely to be in a stronger position to participate in the types of positive social interactions that develop and maintain friendships.

Concerns over the outcomes for TD children who participate in peer-mediated interventions have been reported, specifically in relation to the appropriateness of the responsibility placed on the peers and their ability and motivation to assist as an agent of change (Ogle & Alant, 2014). In addition, peer-mediated interventions raise ethical concerns that are not present in clinician-led interventions. To ensure ethical implementation of a peer-mediated intervention, peers must be adequately equipped to carry out their role as an agent of change within the intervention and provide informed consent (Maheady, 1998). Peer-mediated interventions should also be implemented such that no child is negatively impacted by their participation (Maheady, 1998). To date, studies evaluating the impact of peer-mediated interventions on the TD peers have focused on experiences, attitudes and perceptions towards their peers with a disability, and results have been positive (Ferraioli & Harris, 2011; Jones, 2007; Wolfberg & Schuler, 1999). There is, however, a dearth of evidence (be it positive or

negative) on the TD peers' performance in the particular skills area being targeted, and that they are expected to mediate, following peer-mediated interventions.

A recent randomised controlled trial (RCT) evaluated the effectiveness of a pragmatic language intervention for children with autism that combined peer-mediation with video self-modelling, therapist modelling and parent mediated practice embedded within peer-peer social play (Parsons, Cordier, Munro, & Joosten, 2019b). Results for the children with autism showed the intervention was effective in improving children's use of pragmatic language skills while playing with a typically-developing peer. Effects were maintained 3-months following the 10-week intervention and generalised between the clinic and home environments. Purposefully included in the RCT were the usual peers of the children with autism to ensure that social contextual factors (e.g., quality of social-play interactions with those peers) were also targeted within the intervention.

This study focuses on the pragmatic language outcomes of the *typically-developing* (TD) playmates who participated in a peer-mediated intervention studied by Parsons et al. (2019b). Participation in this peer-mediated intervention is unlikely to have a negative effect on TD-playmates' pragmatic language abilities as they are exposed to the same intervention techniques as children with autism. The social play interactions of children with autism and their TD-playmates are supported by trained therapists, and peers also received video-feedback on targeted pragmatic language skills. Whether these intervention techniques have an impact, be it positive or negative, on the pragmatic language skills of TD-playmates is unknown. Specific research questions addressed by this study were:

1. Is a peer-mediated pragmatic language intervention for children with autism effective for improving the pragmatic language of the TD-playmates?

2. Do the TD-playmates who participated in a peer-mediated pragmatic language intervention for children with autism make significant improvements in pragmatic language that are maintained at 3-month follow-up?
3. Do TD-playmates demonstrate equivalent use of pragmatic language in play-based interactions with a peer with autism in the clinic and home post-intervention?
4. What factors moderate the changes in the pragmatic language of TD-playmates following a peer-mediated intervention for children autism?

2.0 Methods

2.1 Trial design and registration

This study used a single-blind randomised controlled trial (RCT) design with two parallel groups; one group received the 10-week intervention immediately (intervention-first) and the other waited for 10-weeks before commencing the intervention (waitlist-first). After completing the intervention, outcomes for participants were also assessed at a 3-month follow-up. While participants were aware of the intervention they received, outcome measures were administered by assessors blinded to participant group allocation. The pragmatic language outcomes for children with autism who participated in the study are reported in Parsons et al. (2019b). This study focuses on the outcomes of the TD-playmates.

The protocol was approved by Curtin University Human Research Ethics Committee (approval HR04/2015), and registered with the Australia New Zealand Clinical Trials Registry (ACTRN12615000008527). Researchers explained participation requirements to parents and children before parents provided written consent on behalf of their children. Children provided written consent (aged >7 years) or verbal assent (aged 6 years).

2.2 Participants

Children with autism were recruited using convenience sampling. A local autism service provider distributed fliers to families on their waitlist and researchers contacted speech

pathology and occupational therapy clinics, local schools, and online forums for speech pathologists and parents of children with autism. Parents of children with autism self-referred their children to the study if they had concerns about their child's pragmatic language and social play skills. Researchers conducted a screening questionnaire with parents via telephone to assess their child's eligibility to participate. Eligible children with autism ($n = 71$) invited a TD-playmate to accompany them in the study.

Dyads (child with autism and TD-playmate) were randomised to a treatment-first group ($n = 35$) or waitlist-first group ($n = 36$). One treatment-first dyad dropped out after 7 sessions, and one treatment-first TD-playmate dropped out after 3 sessions and was replaced by another TD-playmate for the remaining sessions. Two waitlist-first dyads did not return for their second baseline due to family illness, and one waitlist-first TD-playmate did not attend baseline two; another TD-playmate attended instead, from baseline two onwards. One waitlist-first dyad did not commence the intervention due to scheduling conflicts, and one dropped out after 7 sessions. One waitlist-first TD-playmate dropped out after 4 sessions and was replaced by another TD-playmate for the remaining sessions. Three TD-playmates attended with two different children with autism. See Figure 1 for the participant flowchart. Participant demographic information is provided in Table 1.

2.2.1 TD-Playmates

TD-playmates were aged 6-11 years and did not have any neurodevelopmental disorders or concerns reported by parents, teachers or health professionals. Parents also completed the Children's Communication Checklist and Conners Comprehensive Behaviour Rating Scale to confirm there were no concerns for language or behavioural development. All TD-playmates were known to their peer with autism (i.e., siblings or friends) and were of a similar age.

2.2.2. Children with autism

Children with autism were also aged 6-11 years at recruitment. They were required to have a diagnosis of autism or Asperger syndrome in accordance with DSM-IV or 5 (American Psychiatric Association, 2000, 2013), without an intellectual disability. Researchers sighted diagnostic reports from multidisciplinary community teams (i.e., paediatrician, speech pathologist and psychologist) to confirm children's autism diagnoses. Achieving an Expressive Vocabulary Test standard score of ≥ 70 and Test for Auditory Comprehension of Language Elaborated Sentences and Phrases scaled score ≥ 4 were also required for inclusion.

2.3 Instruments

Parent report measures of emotional, behavioural and communication skills were administered as developmental screening tools, as it was important for this study to ensure that included playmates were indeed typically-developing. Two standardised language measures were also administered to children to ensure no severe oral language impairments were present that might affect comprehension of intervention concepts. To capture a holistic view of pragmatic language outcomes, two measures were selected: 1) a measure of pragmatic language *capacity* to assess children's knowledge of pragmatic skills, and 2) a measure of pragmatic language *performance* to assess how children enact pragmatic skills in a naturalistic social interaction.

2.3.1 Screening measures

Children's structural language abilities were screened using the *Expressive Vocabulary Test 2nd Edition* (EVT-2; Williams, 2007) and the Elaborated Sentences and Phrases subtest of the *Test for Auditory Comprehension of Language 4th Edition* (TACL-4; Carrow-Woolfolk, 2014). The EVT-2 evaluates expressive vocabulary and word recall. It has strong internal consistency ($\alpha = 0.96$) and test-retest reliability ($r = 0.95$) (Williams, 2007). The *Elaborated Phrases and Sentences* subscale of the TACL-4 assesses receptive syntax. At the selected cut-

off (scaled score of 4), the subscale has sensitivity and specificity values of 0.22 and 1.00 respectively, for identifying children with language impairment (Carrow-Woolfolk, 2014).

Parent report measures screened children's behaviour and communication profiles. The *Children's Communication Checklist 2nd Edition* (CCC-2; Bishop, 2006) evaluated language content, form and pragmatics. The *Conners Comprehensive Behaviour Rating Scale* (CCBRS; Conners, 2008) evaluated social, academic, emotional and behaviour problems. The CCC-2 identified children with autism symptomology and pragmatic language difficulties with a sensitivity value of 0.89 and specificity value of 0.97 (Bishop, 2006). The clinical indexes of the CCBRS have correct classification rates of 0.70-0.89 overall (Conners, 2008).

2.3.2 Performance outcome measure

The *Pragmatic Observational Measure, 2nd edition* (POM-2; Cordier et al., 2018) measured children's pragmatic language performance in this study. It is an observational measure that operationalises the adopted definition of pragmatics, with items evaluating communicative skills as well as language use related to socioemotional understanding. The POM-2 is suitable for evaluating children's pragmatic language during peer-peer social play interactions. The measure produces a Non-verbal Communication Element measure and a Verbal Communication Element measure, as well as an Overall measure score. Evidence for the psychometric properties of the POM-2 indicate strong internal consistency ($\alpha = 0.99$), construct validity (97% of people and 99% of times fit Rasch expectations), and criterion validity ($r = 0.95$, $p = 0.005$) when compared to the Pragmatic Protocol (Cordier et al., 2018; Cordier, Munro, Wilkes-Gillan, Speyer, & Pearce, 2014).

To evaluate children's pragmatic language, all dyads were filmed playing in the clinic playroom for 15-minutes at each assessment time-point. Additional dyad footage was taken at the homes of the children with autism at 3-month follow-up. The de-identified footage was then viewed by an independent assessor who rated children's pragmatic language using the

POM-2. The assessor was naïve to study purpose, children's diagnoses and relationship, group allocation, and timing of the videos. Rasch analysis confirmed the reliability of the assessor's scores for the 310 videos in the sample, with goodness of fit statistics falling within the expected parameters ($MnSq < 1.4$ and > 0.7 ; standardised value < 2.0).

2.3.3 Capacity outcome measure

The *Social Emotional Evaluation* (SEE; Wiig, 2008) evaluated social-emotional understanding and high-level language skills. The age-normed test contains four subtests, each evaluating a different aspect of socioemotional language use and high-level language skills (e.g., sarcasm, inferencing). Subtests contain an expressive and a receptive language task; receptive and expressive task scores are summed separately to create a Receptive Composite score and an Expressive Composite score. Composite scores are combined to create a Total Composite score. The SEE has sensitivity and specificity values of 0.95-1.00 for identifying children with autism at a z -score cut-off of -1.00, good internal consistency ($\alpha = 0.76 - 0.88$) and inter-rater reliability ($r = 0.96-1.00$; Wiig, 2008).

2.4 Procedures

2.4.1 Randomisation

As recruitment was sporadic, dyads were randomised in pairs to the treatment-first or waitlist-first groups. An independent researcher used an online random number generator (random.org; Haahr, 2010) to allocate participants to either group 1 (treatment-first) or group 2 (waitlist-first) and concealed allocated group numbers into opaque envelopes. Researchers handed envelopes to families to open after baseline assessments were complete to ensure children, parents, researchers and assessors were blinded to group allocation at baseline.

2.4.2 Assessment procedures

At baseline assessment, dyads entered the playroom at the clinic to play for 15-minutes. Prior to commencing the play, a therapist-researcher orientated dyads to the playroom and

explained the playroom rules. Parents and the therapist-researcher observed the dyads playing on a computer screen in an adjacent room and discussed the social communication difficulties of the child with autism. Children left the playroom after 15-minutes to complete standardised assessments. Parents completed the parent-report questionnaires at this time.

Post-intervention and follow-up assessment procedures were the same as the baseline assessment procedures. At 3-month follow-up, researchers also attended the homes of the children with autism to film dyads playing in an alternative environment. Play recorded at home included indoor and outdoor play, with the children's own toys. Researchers recorded the play session at home using handheld cameras.

2.4.3 Intervention procedures

The intervention consisted of clinic-based and home-based components and was conducted by a speech pathologist and an occupational therapist trained to deliver the intervention and supported by the second author. Mutual availability determined which therapist children were allocated to, and dyads attended ten, weekly, clinic-based sessions. Sessions one and ten consisted of assessment, while the intervention was delivered during sessions two through to eight. To maximise participation, "catch-up" sessions were scheduled if children missed an appointment. Of the 65 dyads who completed a post-assessment, 95% completed the eight intervention sessions. Three dyads were unable to commit to the full eight session schedule so post-assessments were conducted after six sessions for two dyads and seven sessions for one dyad. The average time to complete the eight intervention sessions was 8.3 weeks (SD = 2.4).

All intervention sessions consisted of: 1) 15-20 minutes therapist-led discussion of video-feedback; 2) 20-minutes of child-led, free play with the therapist present; and 3) 15 minutes of discussion between the therapist and parent while the children continued to play. Toys in the clinic playroom were selected to encourage a variety of social-play activities and

cater to a range of ages and interests. See Parsons, Cordier, Munro, and Joosten (2019a) for a full list of toys and equipment available to children. The play component of all clinic sessions was filmed using two wall-mounted digital video cameras inside the playroom.

During video-feedback, the therapist showed dyads 30-40 second clips of footage from the previous week's intervention session. Some clips exemplified pragmatic language that promoted the social interaction (e.g., developing and extending a conversation by making contingent contributions), while others illustrated pragmatics that did not promote the social interaction (e.g., continual rejections of peer's suggestions to focus on own interests). After viewing each clip, the therapist discussed the observed pragmatic language with the dyads. Discussions aimed to help children understand the socioemotional impact of their verbal and non-verbal language during play, with the view to help both children learn pragmatic language strategies to promote positive, play-based social interactions with each other. For children with autism this meant using new pragmatic language skills or enacting existing skills more expertly or more consistently. For TD-playmates, this meant using their more expert (relative to the child with autism) verbal and non-verbal communication skills to model, support and prompt the targeted pragmatic language skills for their peer with autism. Intervention targets were individualised for each dyad and derived using the pragmatic language behaviours operationalised within the POM-2. Table 2 lists some of the pragmatic language skills that were targeted through the intervention. The video-feedback component of the session ended with video-feedforward, in the form of 2-3 short phrases detailing the pragmatic language skills children should aim to use during that day's play session.

Following video-feedback, dyads entered the playroom with the therapist to play. This free-play component of the intervention session provided the dyad with opportunities to practise the pragmatic language strategies discussed during video-feedback in a supported social context. Play activities were child-led and the therapist engaged in the play as a playmate

to model targeted pragmatic language skills for the child with autism (e.g., telling their peer about a new play idea if initiating or maintaining conversations was a target). The therapist also modelled supportive strategies for TD-playmates (e.g., questioning if the child with autism provided too little information in their explanations). Therapist modelling was graded such that as dyads demonstrated improved pro-social play during intervention sessions, they would spend more time playing without the therapist being present in the room.

Home-based intervention components were mediated by parents of children with autism. Parents read modules in a parent manual between clinic sessions, while children with autism viewed videos of fictional characters engaging in free-play and parents guided a discussion about observed pragmatic language. Parents also arranged a weekly playdate for dyads at the home of the child with autism between intervention sessions. Playdates provided dyads with the opportunity to practise and reinforce pragmatic skills learned in the clinic sessions to facilitate the generalisation of skills between the clinic and home environments for the child with autism. Parents discussed their implementation of the home-based intervention components with the therapists each week. Parents regularly reported reading the manual, viewing the videos with their child, and arranging playdates on a weekly basis, however, compliance was not formally assessed.

2.5 Analysis plan

2.5.1 Data preparation

Ordinal POM-2 item ratings were entered into Winsteps (Version 3.92.0; Linacre, 2016) and converted to interval level scores using Rasch analysis. A POM-2 Overall, Verbal Communication and Non-verbal Communication measure score was obtained for all TD-playmates at all assessment time points. TD-playmates who dropped out were excluded from the analysis when only baseline data had been collected ($n = 2$). Participant demographic, screening and outcome measure data were entered in IBM SPSS (Version 22; IBM

Corporation, 2013) where all further analyses were conducted. Two sensitivity analyses were conducted: 1) with scores removed for TD-playmates who replaced drop-outs, and 2) with second round of attendance scores removed for TD-playmates who attended twice. The significance of results in both analyses remained unchanged, so no further data were excluded.

2.5.2 Power

Power calculations were preformed using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007). With a sample size of 33 participants per group, this study was powered to detect a medium effect (Cohen's $d = 0.5$) using a t -test with 80% power and an alpha of 0.05 (two tailed significance).

2.5.3 Baseline comparisons

Parametric tests were used as Shapiro-Wilkes test of normality indicated that data were normally distributed. Independent samples t -tests for interval data and Pearson Chi Square tests for categorical data were used to compare baseline demographic and screening data for parents and children in each group. Results are reported in Table 1. No statistically significant differences were detected for any demographic variables at a significance level of $p < 0.05$. TD-playmate screening assessment scores did not differ between groups.

2.5.4 Change score comparisons

A change-score was calculated for each participant for all POM-2 measure scores and SEE composite scores by deducting baseline 1 scores from post-intervention scores (treatment-first group) or baseline 1 from baseline 2 scores (waitlist-first group). The mean change scores were compared using independent samples t -tests to determine whether changes made by the intervention-first TD-playmates ($n = 33$) over their intervention period were larger than those made by waitlisted-first TD-playmates ($n = 33$), while they waited 10-weeks to start the intervention. Significant was set at $p < 0.05$, and Cohen's d effect sizes were calculated (Cohen, 1988). Cohen's d was interpreted as follows: small $\geq .20$, medium $\geq .50$, or large $\geq .80$.

2.5.5 Changes over time

Linear mixed models assessed the fixed effect of time (pre, post, 3-month follow-up) on all POM-2 measures and SEE composites, allowing for participant level random intercepts, to evaluate changes in TD-playmates pragmatic language over time. Pairwise comparisons of main effects were made between each assessment time point. For 3-month follow-up POM-2 scores, those from the clinic play session were used so that the play environment remained consistent across time for this analysis. Significance was set at $p < 0.05$, and Cohen's d effect sizes were calculated and interpreted using the convention previously described.

2.5.6 Differences between environments

To evaluate whether the TD-playmates demonstrated equivalent pragmatic language performance in the clinic and home environments at the end of the study, a difference-score was calculated for all POM-2 measures for TD-playmates who completed both follow-up assessments ($n = 64$). POM-2 difference-scores were calculated by deducting 3-month follow-scores from the clinic play session from 3-month follow-up scores from the home play session. Single sample t -tests were conducted on the difference-scores for each POM-2 measure to determine whether they were equivalent to zero. Pragmatic language performance was considered to be comparable across environments if results were not significant ($p > 0.05$).

2.5.7 Moderators of pragmatic language performance and knowledge

The effect of six covariates on the pragmatic language scores of TD-playmates was assessed using linear mixed models. Allowing for participant level random intercepts, models were assessed for all POM-2 measures and SEE composites. First, simple linear mixed model regression was performed to detect significant interactions in six covariates. Covariates assessed were time (pre-, post-, 3-month follow-up), expressive vocabulary (EVT-2 standard score), receptive syntax (TACL-4 subtest scaled score), TD-playmate relationship (sibling, non-sibling), TD-playmate age group (6-7yrs, 8-9yrs, 10-11yrs), and therapist profession

(speech pathologist, occupational therapist). Then, multiple regression was performed by entering all significant simple interactions covariates into the models and removing non-significant covariates via a process of backwards elimination until only significant moderating variables remained. Significance was set at $p < 0.05$.

3.0 Results

3.1 Change score comparisons

For intervention-first TD-playmates, all POM-2 and SEE mean change scores were positive. For waitlist-first TD-playmates, the POM-2 Overall and Nonverbal change scores were negative, the POM-2 Verbal change score was positive, the SEE Receptive change score was negative, and the SEE Expressive and Total change scores were positive. Independent samples *t*-tests revealed no significant differences between pragmatic language changes made by the intervention-first TD-playmates over the intervention period and the waitlist-first TD-playmates during their 10-week wait (see Table 3).

3.2 Changes over time

The POM-2 measure scores and SEE composite scores were combined for TD-playmates from both intervention first and waitlisted groups to increase the power of remaining analyses ($n = 66$). Table 4 details results of the linear mixed models used to analyse the effect of time on POM-2 and SEE scores. The main effect of time was significant for POM-2 Overall ($F(2,128) = 18.42, p < 0.001$), Non-verbal ($F(2,128) = 17.02, p < 0.001$) and Verbal measures ($F(2,128) = 15.94, p < 0.001$). Pre to post score comparisons were significant with medium, positive effect sizes for POM-2 Overall ($p < 0.001, d = 0.45$), Non-verbal ($p < 0.001, d = 0.51$) and Verbal measure scores ($p < 0.001, d = 0.50$), as were pre to 3-month follow-up POM-2 comparisons ($p < 0.001, d = 0.59-0.63$). While mean POM-2 scores increased between post and 3-month follow-up for all three measures, no significant differences were found and effect sizes were negligible. This suggests that changes in TD-playmate's pragmatic language

performance during play-based interactions with a peer with autism maintained following the intervention period.

The main effect of time was also significant for SEE Total ($F(2,127) = 6.84, p = 0.002$), SEE Receptive ($F(2,126) = 5.81, p = 0.004$) and SEE Expressive ($F(2,127) = 5.09, p = 0.007$) scores. Pre to post score comparisons were significant with small, positive effect sizes for SEE Total ($p < 0.002, d = 0.31$), Receptive ($p < 0.009, d = 0.22$) and Expressive scores ($p < 0.014, d = 0.23$), as were pre to 3-month follow-up SEE score comparisons ($p = 0.002-0.003, d = 0.27-0.30$). No significant differences were observed for SEE scores between post and 3-month follow-up and effect sizes were negligible suggesting that changes in TD-playmate's pragmatic language capacity maintained following the intervention period.

3.3. Differences between environments

Mean POM-2 Overall scores for TD-playmates at 3-month follow-up were higher when playing at the home of their peer with autism (mean = 55.71, ± 30.74) than in the clinic (mean = 53.19, ± 29.24), as were POM-2 Non-verbal scores (home mean = 63.08, ± 34.01 ; clinic mean = 57.39, ± 32.04). Mean 3-month follow-up POM-2 Verbal scores for TD-playmates were higher in the play-based interaction at the clinic (mean = 49.60, ± 36.18) than at the home of their peer with autism (mean = 24.21, ± 37.91). Single sample *t*-tests comparing follow-up POM-2 difference scores (home score – clinic score) to zero were not significant for POM 2 Overall ($t(61) = 0.67, p = 0.506$), Non-verbal ($t(61) = 1.34, p = 0.185$), and Verbal ($t(61) = -0.32, p = 0.752$) scores. This suggests that TD-playmate's pragmatic language performances during play-based interactions with a peer with autism at the end of the study were equivalent in the clinic and in the homes of their peers with autism.

3.4 Moderators of pragmatic language performance

Simple interaction effects of six covariates: 1) time (pre-, post-, 3-month follow-up); 2) expressive vocabulary (EVT-2 standard score); 3) receptive syntax (TACL-4 subtest scaled

score); 4) TD-playmate relationship (sibling, non-sibling); 5) TD-playmate age group (6-7yrs, 8-9yrs, 10-11yrs), and 6) therapist profession (speech pathologist, occupational therapist) on POM-2 measures and SEE composite scores were assessed. No significant main effects were present for any of the POM-2 measures for receptive syntax (TACL-4 score) or expressive vocabulary (EVT-2 scores). A significant main effect of TD-playmate relationship (sibling vs. non-sibling) was detected for POM-2 Overall ($F(1, 65) = 6.50, p = 0.013$), Non-verbal ($F(1, 65) = 6.04, p = 0.017$) and Verbal ($F(1, 65) = 7.04, p = 0.010$) measures. The effect favoured dyads who were not siblings. Therapist profession (speech pathologist vs. occupational therapist) also produced a significant main effect, favouring speech pathologist as the interventionist, on POM-2 Overall ($F(1, 65) = 14.17, p < 0.001$), Non-verbal ($F(1, 65) = 11.97, p < 0.001$) and Verbal ($F(1, 65) = 18.62, p < 0.001$) measures. The main effect of TD-playmate age group (6-7yrs, 8-9yrs, 10-11yrs) was significant for POM-2 Overall ($F(2, 66) = 3.46, p = 0.038$) and POM-2 Non-verbal ($F(2, 63) = 3.22, p = 0.047$), but not for the POM-2 Verbal measure. Main effects increased with age. Expressive vocabulary was the only significant covariate for SEE Total ($F(1, 61) = 10.80, p = 0.002$), SEE Receptive ($F(1, 61) = 9.75, p = 0.003$) and SEE Expressive ($F(1, 61) = 6.41, p = 0.014$) composite scores. Higher EVT-2 scores were related to greater changes in SEE scores.

Multiple linear mixed regression models were examined for all POM-2 measure scores and SEE composite scores by entering significant simple interaction covariates into each model and then removing non-significant covariates through backwards elimination. Significant explanatory variables for the POM-2 Overall measure scores were time (pre, post, 3-month clinic follow-up), TD-playmate relationship (sibling, non-sibling), therapist profession (speech pathologist, occupational therapist) and TD-playmate age group (6-7yrs, 8-9yrs, 10-11yrs). Covariates of time (pre, post, 3-month clinic follow-up), TD-playmate relationship (sibling, non-sibling) and therapist profession (speech pathologist, occupational therapist) were

significant for POM-2 Non-verbal and Verbal measure scores (Table 5). All SEE composites shared the same two significant explanatory covariates: expressive vocabulary (EVT-2 score) and time (pre, post, 3-month follow-up) (see Table 6).

4.0 Discussion

This study aimed to investigate the pragmatic language outcomes for TD-playmates involved in a peer-mediated, play-based pragmatic language intervention for children with autism. Results indicated that the pragmatic language *performance* (POM-2) of the typically-developing peers improved significantly over the 10-weeks of intervention, effects were maintained 3-months later, and scores were equivalent across the clinic and home environments; mirroring the results of their peers with autism (Parsons et al., 2019b). It was expected that TD-playmates would refine and impart the pragmatic language skills required to maintain a positive social-play interaction, as peer-modelling is a driver of change for target children in peer-mediated interventions. However, change score comparisons between the intervention-first and waitlisted peers suggest that TD-playmate's pragmatic performance improvements were not significantly greater than the improvements made by the TD-playmates in the waitlisted group.

The TD-playmates included in the study were siblings (76%) and friends (24%) of the children with autism. Differences in language, cognition and social engagement have been noted for siblings of children with autism in early development; however, observed differences are much less pronounced once children reach school age (Gamliel, Yirmiya, Jaffe, Manor, & Sigman, 2009). Furthermore, children with autism are more likely to have friends with a disability, including autism, than typically-developing children (Petrina, Carter, & Stephenson, 2014). Despite the risk of social, cognitive and language difficulties amongst the usual peers of children with autism, behavioural and language screening conducted at baseline confirmed that this group of TD-playmates were indeed typically-developing. While the variability of

gains in the intervention-first and waitlist-first groups was too large for differences in gains to be statistically significant, results indicate that the pragmatic language performance of typically-developing children increased significantly after participation in this intervention, and participation in the intervention produced no negative effects on pragmatic language performance.

In addition to pre-post intervention improvements in pragmatic language performance, results indicated that TD-playmates maintained those gains 3-months following the intervention period. Furthermore, TD-playmates demonstrated equivalent pragmatic language performance at follow-up within the home and clinic environments. This finding was largely to be expected as TD-playmates were unlikely to have the same difficulties with pragmatic language and skill generalisation as their peers with autism (Rao, Beidel, & Murray, 2008). These results do, however, further confirm that participation in this intervention does not have a negative impact on the pragmatic language of typically-developing children. TD-playmates were expected to act as a key agent of change within this intervention, particularly for the facilitation of skills maintenance and generalisation for their peers with autism, as children were likely to continue to play and interact away from the clinic environment. These maintenance and generalisation findings for TD-playmates mirror those of their peers with autism (Parsons et al., 2019b), suggesting that TD-playmates may have assisted in facilitating the desired skills maintenance and generalisation for their peers with autism. However, the interaction between gains, maintenance and generalisation made by children within each dyad is not yet well understood and requires further investigation.

Although the behavioural and language screening at baseline confirmed that TD-playmates had age appropriate behavioural and language profiles, their POM-2 scores across the study were only marginally greater than those of their playmates with autism (Parsons et al., 2019b). The POM-2 evaluates one child's pragmatic language performance during a play

interaction with another child, and, as such, it is possible that a child's pragmatic language score could be influenced by the abilities of their play partner due to the transactional nature of play. To date, studies utilising the POM or POM-2 have only analysed individual children's scores, rather than the interaction between scores within a dyad. Further investigation is required to understand whether an interaction between POM-2 scores within a dyad is present. In addition, future research should also measure TD-playmates' pragmatic language performance during play with another TD child. Such data would help to tease out the TD-playmate's abilities from the interdependence on their peer's abilities.

The relationship of the TD-playmate to the child with autism was a significant moderator of TD-playmates' pragmatic language performance during the study. Non-sibling TD-playmates demonstrated stronger pragmatic language performance than sibling TD-playmates. These results are in contrast to the findings for children with autism in the study; their relationship to their TD-playmate did not moderate their pragmatic language performance (Parsons et al., 2019b). When considering the associations between conversational features, social cognitive development, language ability and relationship quality, Cutting and Dunn (2006) also found differences between the conversational features, shared pretence and conflict of typically-developing children when comparing child-friend and child-sibling interactions. Both their findings and ours, highlight the importance of considering the role that relationships and conversations play in the development of social skills.

Cutting and Dunn (2006) were unable to analyse the variables contributing to the relational differences in their study due to sample size restrictions. The POM-2, used to evaluate interactions in this study, gauges the quality of a social interaction from a communicative and socioemotional perspective. Our results suggest that for typically-developing, school-aged children, child-friend conversations contribute to greater gains in language behaviours related to socioemotional understanding than child-sibling interactions.

Children cannot choose their siblings, but they enter into friendships voluntarily. Thus, they are perhaps more likely to be motivated to promote continued positive interactions with non-sibling peers than sibling peers.

Another possible explanation is that the quality of a relationship might predict how children use or gain socioemotional understanding (Cutting & Dunn, 2006). While siblings of children with autism report less competition and conflict within their relationship than typically-developing siblings, they also report less intimacy and prosocial behaviour (Kaminsky & Dewey, 2001). Moreover, compared to typically-developing children, children with autism are at an increased risk of being involved in sibling bullying, both as the victim and as the bully (Toseeb, McChesney, & Wolke, 2018). It is therefore possible that some sibling dyads within this study had more hostile relationships at the outset, which, in turn, contributed to sibling TD-playmates demonstrating weaker pragmatic language performance than non-sibling TD-playmates. The decision to include siblings as peers in this study was driven by feasibility (i.e., siblings were preferred by parents as a child with autism may not have a typically-developing friend who can attend the intervention). However, the decision to include siblings in peer-mediated interventions for children with autism may instead need to strike a balance between feasibility and relationship quality. To test this hypothesis, future studies might consider a priori measures of children's relationship quality to investigate whether this has a stronger moderating effect on findings than relationship type (i.e., sibling vs. friend).

The professional background of the therapists conducting the intervention also moderated the POM-2 scores of TD-playmates in this study. TD-playmates in dyads attending the intervention conducted by the speech pathologist made greater pragmatic language gains than those who attended the intervention conducted by the occupational therapist. This finding could be explained by differences in professional expertise; a speech pathologist is more likely

to have a deeper understanding of pragmatic language. However, only one therapist from each profession delivered the intervention, as such, the result should be interpreted with caution. This intervention though, also presents an ideal opportunity for collaboration between speech pathologists and occupational therapists, and, these findings indicate that training for occupational therapists should equip them with a deeper understanding of pragmatic language to maximise the integration of pragmatic language goals into an intervention for an important childhood occupation.

Typically-developing peers demonstrated significantly improved pragmatic language *capacity* (SEE) over the intervention period that was maintained at the 3-month follow-up. However, the comparisons of change scores for the intervention-first and waitlisted peer groups did not differ significantly. These change score results mirror those of the children with autism in this study; change scores were not significantly different between the intervention-first group and the waitlisted autism group, but significant gains in SEE scores were observed from pre- to post-intervention and maintained at 3-month follow-up (Parsons et al., 2019b). However, the direction of change in pragmatic capacity scores between post-intervention and 3-month follow-up differed for children with autism and their TD-playmates. TD-playmates' 3-month follow-up scores were equivalent to or greater than post-intervention scores, but follow-up scores for children with autism were lower than post-intervention scores (Parsons et al., 2019b). Pragmatic language capacity (i.e., pragmatic knowledge) and theory of mind (ToM) have been broadly linked in the literature (Matthews, Biney, & Abbot-Smith, 2018), and evidence for ToM interventions indicates that effects are not maintained for children with autism (Fletcher-Watson, McConnell, Manola, & McConachie, 2014), so it is unsurprising that children with autism did not maintain gains in pragmatic knowledge (SEE scores) in this study once the intervention was withdrawn. On the other hand, typically-developing peers were not expected

to have the same difficulties with pragmatic knowledge and ToM and would therefore be more likely to maintain the knowledge gained during the intervention.

The pragmatic language capacity of peers during the study was moderated by their expressive vocabulary capacity. The assessment tasks contained within the SEE require children to use oral language skills to comprehend questions and provide responses. It therefore appears that children with stronger structural language would demonstrate stronger performance. The confounding effect of oral language skills on the measurement of pragmatic knowledge suggests standardised assessments evaluating children's meta-pragmatics provide only a portion of the total picture. When considering an individual's functioning, the ICF combines both discrete skill capacities with performance in natural contexts (World Health Organization, 2001). Therefore, evaluations of social functioning related to pragmatic language should include standardised evaluations of capacity (such as the SEE) along with observational measures of how those skills are performed during meaningful social interactions.

Overall, results from the study indicate that there was a positive effect on the pragmatic language skills of the TD-playmates involved and thus the quality of social interaction that the children with autism have with that TD-playmate, be they siblings or friends. These findings are limited, however, to interactions with a single social partner. Further research is required to understand the ideal peer, combination of peers, and modes of delivery (e.g., clinic, home and classroom) that maximise intervention effects for children with autism and TD-playmates, both in terms of influencing their own pragmatic language abilities, but also the quality of their social environments. Furthermore, for a more holistic investigation the impact this intervention has on all contextual factors related to play-based interactions for children with autism, the perceptions and attitudes of the typically-developing peers should also be evaluated. Studies that have evaluated these aspects of the social context have found positive changes in attitudes and typically-developing children's inclinations to engage socially with their peers with autism

(Whitaker, Barratt, Joy, Potter, & Thomas, 1998; Wolfberg & Schuler, 1999). Future studies of peer-mediated interventions should include examination of skill performance and attitudinal change.

4.1 Conclusion

This study found that attending a peer-mediated pragmatic language intervention for children with autism significantly improved the pragmatic language of the typically-developing peers involved in the intervention. While this change cannot be exclusively attributed to the intervention, benefits were maintained at 3-month follow-up and were found to be similar across clinic and home environments. This study raises important questions about the influence of a child's TD-playmate on their pragmatic performance, and the influence that the nature and quality of a child's sibling and friend relationships might also have on their conversational and socioemotional development. Inclusive interventions are well placed to improve the social environments of children with autism and we hope that by targeting pragmatic language in this way that peer-peer interactions during play can be sustained for friendships to develop and be maintained. This cascading effect still needs to be empirically tested, but equipping children with autism with more expert pragmatic language skills and the social context of a peer willing and able to play and interact, is an important first step.

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Figure 1. CONSORT flowchart

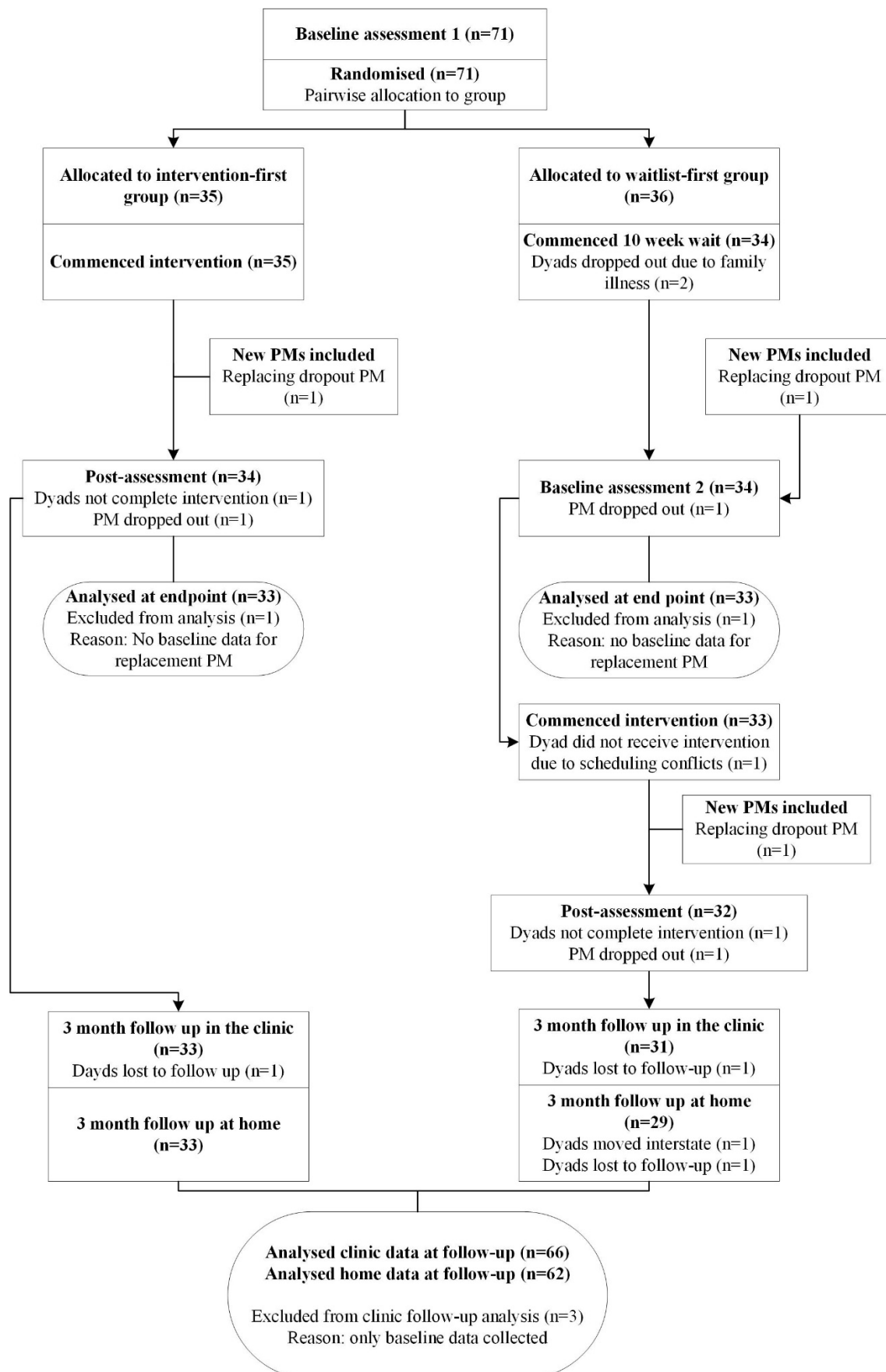


Table 1. Participant demographic and screening variables

	Playmates			Children with Autism		
	Intervention-First	Control-First	<i>p</i>	Intervention-First	Control-First	<i>p</i>
Parent Demographics^a						
Age (years)	41.76 (5.58)	39.65 (6.75)	0.183	42.20 (5.95)	40.59 (3.94)	0.210
Education after high school	24 of 34	28 of 34	0.292	23 of 32	26 of 33	0.501
Child Demographics						
Age (years)	8.67 (1.73)	8.03 (1.49)	0.111	8.68 (1.38)	8.40 (1.36)	0.411
Gender (male)	15 of 34	20 of 34	0.225	31 of 34	28 of 34	0.283
English first language	32 of 34	34 of 34	0.134	33 of 34	34 of 34	0.314
European Australian	31 of 34	32 of 32	0.641	31 of 34	32 of 34	0.667
Screening Assessments						
CCBRS ^b						
Autistic disorder	49.30 (9.60)	55.66 (15.92)	0.067	86.37 (7.29)	85.48 (7.37)	0.645
Asperger's disorder	49.03 (8.97)	53.07 (12.16)	0.151	81.80 (10.30)	79.03 (11.06)	0.345
CCC-2 ^c						
General Communication Composite	74.31 (19.18)	73.04 (22.14)	0.822	38.34 (13.03)	35.37 (17.15)	0.466
Social Interaction Difference Index	0.31 (7.99)	0.16 (7.40)	0.943	-10.93 (8.25)	-4.44 (8.02)	0.007*
EVT-2	106.48 (12.89)	110.72 (11.45)	0.167	102.76 (14.68)	104.39 (12.50)	0.627
TACL-4	8.70 (1.74)	9.27 (1.94)	0.209	8.12 (2.68)	8.44 (2.09)	0.581
Dyad Variables						
Age difference (months)	0.72 (22.92)	-5.76 (19.32)	0.214			
Playmate sibling	18 of 34	21 of 34	0.462			

Note: CCBRS = Conners Comprehensive Behaviour Rating Scale, CCC-2 = Children's Communication Checklist 2nd Edition, EVT-2 = Expressive Vocabulary Test 2nd Edition, TACL-4 = Test for Auditory Comprehension of Language 4th Edition; ^aNumber of parents no equal to number of children with autism as two families enrolled multiple children with autism; ^bClinical cut off = T-score > 70, borderline clinical cut off = T-score > 65; ^cGeneral Communication Composite < 55 and a Social Interaction Difference Index < 0 suggests a communication profile indicative of autism; **p* < 0.05.

Table 2. Pragmatic language behaviours targeted within the intervention.

Pragmatic language behaviour
<ul style="list-style-type: none"> • Selecting a range of conversation topics • Conversation topic maintenance and change • Contingency with previously communicated content • Initiating verbal communication • Responding to playmate's communication • Repairing or revising communication to resolve breakdowns • Using and responding to facial expressions • Using and responding to gestures (i.e., body movements or actions) • Using and responding to body positioning • Using physical space between playmates appropriately • Being aware of and responsive to playmate's emotional needs • Integrating playmate's perspective or emotions • Using verbal and non-verbal language appropriate to the social context • Adapting behaviour and language to environmental demands • Attending to playmate's communicative content, planning and initiating appropriate responses • Planning and delivering organised communication content • Resolving conflicts • Cooperating to promote a mutually beneficial exchange • Engagement in play-based interaction with playmate • Effectively expressing viewpoint, emotions or opinions • Making suggestions and effectively offering opinions • Disagreeing effectively so that the interaction is continued

Table 3. Between-groups comparisons of playmate change scores

Measure	Intervention-First (n = 33)		Control-First (n = 33)		Change score comparisons		Effect size
	<i>Mean (SD)</i>		<i>Mean (SD)</i>		<i>t</i>	<i>p</i>	<i>d</i>
	Baseline 1	Post-Intervention	Baseline 1	Baseline 2			
POM-2							
Overall	34.88 (29.67)	45.29 (32.10)	20.44 (27.48)	21.48 (30.01)	1.56	0.124	0.38
Nonverbal	36.54 (32.23)	50.16 (36.44)	23.07 (29.22)	23.02 (32.43)	1.87	0.066	0.46
Verbal	28.23 (35.50)	38.04 (37.73)	8.30 (33.59)	13.00 (32.98)	0.83	0.411	0.20
SEE							
Receptive	0.12 (0.61)	0.29 (0.83)	-0.12 (0.81)	-0.02 (1.19)	0.34	0.738	0.07
Expressive	0.09 (1.02)	0.43 (0.83)	-0.30 (0.95)	0.23 (1.12)	-0.66	0.512	0.16
Total	0.12 (0.84)	0.42 (0.82)	-0.21 (0.96)	0.16 (1.14)	-0.23	0.816	0.06

Note: POM-2 = Pragmatics Observational Measure 2nd Edition; SEE = Social-Emotional Evaluation; Cohen's *d* interpretation: 0.2 = small, 0.5 = medium, 0.8 = large.

Table 4. Comparison of playmate outcome measures over time

Measure	Test of Fixed Effects		Estimated Marginal Means			Pairwise comparisons ^a					
	<i>F</i>	<i>p</i>	Pre- <i>Mean (SE)</i>	Post- <i>Mean (SE)</i>	3-mth follow-up <i>Mean (SE)</i>	Pre Post <i>p</i>	<i>d</i>	Pre Follow-up <i>p</i>	<i>d</i>	Post Follow-up <i>p</i>	<i>d</i>
POM-2											
Overall	18.42	<0.001***	28.22 (3.76)	47.32 (3.71)	53.23 (3.76)	<0.001***	0.45	<0.001***	0.59	0.169	0.14
Nonverbal	17.02	<0.001***	29.80 (4.17)	50.86 (4.12)	57.39 (4.17)	<0.001***	0.51	<0.001***	0.60	0.185	0.09
Verbal	15.94	<0.001***	21.16 (4.44)	40.45 (4.38)	49.68 (4.44)	<0.001***	0.50	<0.001***	0.63	0.073	0.13
SEE											
Total	6.84	0.002**	0.15 (0.12)	0.56 (0.12)	0.55 (0.12)	0.002**	0.31	0.002**	0.30	0.961	-0.01
Receptive	5.81	0.004**	0.09 (0.10)	0.35 (0.10)	0.41 (0.10)	0.009**	0.22	0.002**	0.27	0.570	0.05
Expressive	5.09	0.007**	0.17 (0.12)	0.48 (0.12)	0.55 (0.12)	0.014*	0.23	0.003**	0.27	0.603	0.05

Note: POM-2 = Pragmatics Observational Measure 2nd Edition; SEE = Social-Emotional Evaluation; Cohen's *d* interpretation: 0.2 = small, 0.5 = medium, 0.8 = large; ^aPOM-2 scores from 3-month follow-up assessment in the clinic; **p* < 0.05; ***p* < 0.01; ****p* < 0.001.

Table 5. Final results of linear mixed model for playmate POM-2 scores.

Fixed Factor	POM-2 Overall			POM-2 Nonverbal			POM-2 Verbal		
	EM Mean (SE)	<i>F</i>	<i>p</i>	EM Mean (SE)	<i>F</i>	<i>P</i>	EM Mean (SE)	<i>F</i>	<i>p</i>
Time		17.92	<0.001***		16.45	<0.001***		15.27	<0.001***
Pre	32.78 (3.68)			32.48 (4.04)			24.39 (4.18)		
Post	51.63 (3.63)			53.21 (3.97)			43.27 (4.11)		
Follow-up ^a	57.45 (3.67)			59.60 (4.02)			52.30 (4.17)		
Playmate Relationship		6.21	0.015*		5.00	0.029*		6.20	0.015*
Sibling	41.08 (3.22)			42.09 (3.48)			32.72 (3.58)		
Non-sibling	53.49 (4.07)			54.77 (4.47)			47.25 (4.60)		
Therapist Profession		10.87	0.002**		10.32	0.002**		16.81	<0.001***
OT	39.25 (3.58)			39.57 (3.82)			28.352 (3.93)		
SP	55.32 (3.69)			57.29 (4.08)			51.619 (4.20)		
Age Group (yr;mth)		3.41	0.039*						
6;0-7;11	38.55 (3.89)								
8;0-9;11	46.96 (3.69)								
10;0-11;11	56.35 (5.88)								

Notes. POM-2 = Pragmatics Observational Measure 2nd Edition; SEE = Social Emotional Evaluation; TACL-4 = Test for Auditory Comprehension of Language 4th Edition; EVT-2 = Expressive Vocabulary Test 2nd Edition; OT = Occupational Therapist; SP = Speech Pathologist; ^a3-month follow-up assessment in the clinic; **p* < 0.05; ***p* < 0.01; ****p* < 0.001.

Table 6. Final linear mixed model for playmate SEE scores.

Fixed Factor	SEE Receptive			SEE Expressive			SEE Total		
	EM Mean (SE)	<i>F</i>	<i>p</i>	EM Mean (SE)	<i>F</i>	<i>p</i>	EM Mean (SE)	<i>F</i>	<i>p</i>
EVT-2		9.73	0.003**		6.34	0.014*		10.73	0.002**
Time		5.02	0.008**		4.40	0.014*		6.35	0.002**
Pre	0.10 (0.10)			0.19 (0.12)			0.17 (0.11)		
Post	0.35 (0.10)			0.48 (0.12)			0.56 (0.11)		
Follow-up	0.40 (0.10)			0.56 (0.12)			0.57 (0.11)		

Notes. POM-2 = Pragmatics Observational Measure 2nd Edition; SEE = Social Emotional Evaluation; TACL-4 = Test for Auditory Comprehension of Language 4th Edition; EVT-2 = Expressive Vocabulary Test 2nd Edition; OT = Occupational Therapist; SP = Speech Pathologist; ^aPOM-2 scores from 3-month follow-up assessment in the clinic; **p* < 0.05; ***p* < 0.01.