An Examination of Interactions among Children with Autism and their Typically Developing

Peers

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Abstract

Objective: To determine whether preschool children with Autism Spectrum Disorders (ASD) interact differently with their peers with ASD compared to their typically developing (TD) peers, across three activities (free play, structured group time, semi-structured play) in an early intervention setting.

Methods: We completed a series of non-experimental case studies involving 13 children with ASD and 2 TD peers.

Results: We found trends, but no uniform differences, in the frequency or quality of means by which the children with ASD interacted with one another versus with their TD peers across the three contexts. The children with ASD interacted with both peer types more frequently during the semi-structured and structured activities, than during free play.

Conclusions: The children with ASD showed no clear bias towards one peer type over the other. Semi-structured activities may be the best context in which to facilitate peer interactions involving children with ASD in early intervention settings.

Introduction

A fundamental goal of early childhood education programs is to foster children's development of positive peer interactions and relationships. Indeed, it is through positive peer interactions that children learn not only to play together in shared activities [1], but also the fundamental skills necessary for forming positive relationships in adolescence and adult life [2]. However, children with Autism Spectrum Disorders (ASD) have core social, communication, and behavioural impairments that make interacting with peers difficult [3,4]. These impairments jeopardise their ability to learn and participate successfully in early education settings. Therefore, understanding and addressing the needs of children with ASD during peer interactions is both a clinical and research priority.

Peer interactions

To date, research examining the peer-interactions of children with ASD has focused on identifying and addressing the challenges faced in mainstream settings. Anderson, Moore, Godfrey, and Fletcher-Flinn [5], for example, observed the play behaviour and social interactions of 10 children with ASD and their typically developing (TD) peers in mainstream schools, during free-play activities. Although the children with ASD were observed to respond positively to their peers when approached, they displayed less complex forms of social play and initiated interaction less frequently than their TD peers. Furthermore, when the children with ASD did initiate, they directed these bids mostly toward teachers, rather than toward other children [5]. Nevertheless, there is strong evidence that interactions between children with ASD and their TD peers are amenable to interventions aimed at improving their frequency and quality [4,6]. In fact, training young TD peers to implement social-communication interventions in mainstream settings can have generalised benefits for all children involved [7]. However, little is known about the way in which children with ASD

interact with one another in educational settings, and whether their interactions differ in frequency and/or quality compared to their interactions with TD peers in the same setting.

There is some evidence to suggest that children with ASD and other developmental disorders initiate and respond more to TD peers than to peers with disabilities. Tsao et al. [8], for example, investigated the social-participation and interaction rates of children with and without disabilities in inclusive educational settings. They reported that the children with disabilities made more positive interactions toward TD peers, received more positive responses from TD peers, and interacted less with their peers with disabilities. Hauser-Cram, Bronson, and Upshur [9] reported similar findings, based on naturalistic observation of pre-schoolers with disabilities across inclusive and segregated classrooms. The children with disabilities were observed to initiate and respond more frequently to their peers in inclusive classrooms than in segregated classrooms, suggesting that the presence of TD peers might foster more opportunities for successful peer-interaction. However, it is important to note that these two studies examined interactions in established classrooms, where the children spent the entire school week together. It is not clear whether the same patterns of peer interaction would be seen in children with ASD who have consistent, but less frequent, contact with TD peers, such as occurs in reverse inclusion programs.

Reverse inclusion

Reverse inclusion programs involve TD children from general education classrooms joining specialist classrooms , for specified periods of time [10]. Proponents argue that reverse inclusion programs provide the same opportunities for children with ASD to learn from their TD peers as occurs in traditional inclusive settings, while maintaining the specialised teaching environment and supports common to segregated settings. However, despite the appeal of reverse inclusion programs, research to date has focused largely on

parents' perspectives of benefits and risks [11] rather than on outcomes for the children involved. It is not known whether children with ASD actually interact more frequently and with greater success with TD peers than with their peers with ASD, under the reverse inclusion condition. Presumably, if differences were apparent, the findings would inform decisions regarding the relative benefits and opportunities provided by segregated, inclusive, and reverse inclusion programs.

Contextual influences on interaction

There is also strong evidence to suggest that a range of non-child related factors impact on the way children with ASD interact with their peers. Boyd, Conroy, Asmus, McKenny, and Mancil [12], for example, reported that small-group arrangements in educational settings were associated with more frequent interactions among a group of preschool-aged children with ASD than were large-group arrangements. Similarly, Reszka, Odom, and Hume [13] reported more frequent episodes of social engagement among children with ASD when small groups comprised just one or two peers as opposed to one on one with an adult, an adult and one or two peers, a large group with three or more peers and a large group with an adult and three or more peers. These findings suggest that group size can influence the extent to which children with ASD initiate and respond to their peers with/without disabilities. However, it is not clear whether differences in interaction are simply a product of the number of available communication partners, or whether other factors, such as the level of structure provided in small group settings, may also contribute to these differential outcomes.

There is some evidence that children with ASD interact more with their TD peers in structured, as opposed to unstructured settings. Jenkins, Odom, and Speltz [14], for example, compared the effects of structured and semi-structured settings involving children with and

without disabilities. They reported that children engaged in greater amounts of interactive play with one another when teachers were involved. Clifford et al. [3] reported similar findings comparing the communicative behaviours of children with ASD when engaged in structured teacher-lead activities compared to table-top, free-play time. However, Strain and Fox [15], in reviewing the literature on adult-mediated intervention studies, noted that the involvement of teachers in play activities (e.g. positively reinforcing children's play behaviour) has the potential to interrupt peer interactions. Therefore, research is needed to not only examine whether children with ASD interact differently with their peers with ASD compared to with their TD peers, but also to examine the possible influence of context on these interactions, given the different types of activity regularly engaged in early-intervention classrooms.

Given the importance of positive peer interactions in early childhood, and the identified needs of children with ASD, the aim of this study was to identify any differences in the frequency and quality of interactions of children with ASD with one another and with their TD peers. We hypothesised that children with ASD would (a) spend substantial time engaged in solitary play, but would spend more time engaged in parallel and interactive types of play with TD peers than with peers with ASD, (b) initiate and respond more often to TD peers than to peers with ASD, and (c) share attention for longer durations, and share positive affect more frequently with TD peers than with peers with ASD. Given the mixed findings regarding contextual the influences on peer interactions, we did not specify predictions regarding such influence on the children's peer interactions. However, within the framework of a reverse inclusion program, embedded within a community early-intervention setting for children with ASD, we sampled peer interactions across three different contexts; unstructured free play, structured group time, and semi-structured play.

Methods

Design

We completed 13 non-experimental case studies to compare interactions involving children with ASD and their TD peers across three preschool contexts. Part 1 of the study examined interactions between 13 children with ASD and two TD peers during unstructured, outdoor free-play. Part 2 examined interactions between a subset of four of the children with ASD and the same two TD peers included in Part 1, during structured group time and semi-structured play contexts. Dependent variables pertained to behaviour of the children with ASD: frequency of communicative *initiations* and *responses* toward others; duration of *shared attention* with others; frequency of *positive affect* directed towards others; and engagement in *solitary, parallel*, and *interactive* play types. The study was approved by the [name withheld for blind review] human ethics committee.

Setting

The study was conducted in an early intervention classroom for children with ASD, attached to a mainstream community childcare facility. The children with ASD attended the program between 3 and 5 days per week, for between 6 and 8 hours each day, and received comprehensive, group-based early intervention specific to ASD. The program was staffed by a team of allied-health and early childhood education professionals with an adult to child ratio of 1:4.

Participants

Thirteen children with ASD, aged between 21 and 48 months ($M = 39$, $SD = 8.5$), participated in the study. Pseudonyms are used here to maintain confidentiality. All children had a clinical diagnosis of ASD, confirmed by a trained independent assessor using the Autism Diagnostic Observation Schedule-Generic [ADOS-G; 16] on child entry into the

early intervention service. Children's cognitive/developmental level was also assessed at service entry, using the using the Mullen Scales of Early Learning [MSEL; 17].Table 1 presents the sample characterisation, highlighting the range of children's symptom severity and cognitive/developmental ability levels.

Insert Table 1 about here

Two TD boys (aged 45 and 48 months), who were participants in a reverse inclusion program, were tangentially involved in the study. That is, we observed and measured the ways in which the children with ASD interacted with these two children, but did not code the communicative or play behaviours of these boys themselves. The boys were in the ASD-specialist classroom for 90 minutes, 3 times per week, and had been involved in the reverse inclusion program for 6 weeks prior to the commencement of this study. They were present during outdoor free-play, indoor structured group time, and indoor semi-structured play during each visit. A number of teachers/assistants were also tangentially involved, supervising the children during outdoor free-play for Part 1 of this study. One of two teachers led each of the structured group sessions and facilitated the semi-structured play for Part 2 of this study. Again, only behaviour of the children with ASD was coded.

Data collection procedure

The first author attended the classroom two mornings a week, for eight weeks, to film the children as they engaged in outdoor free-play, structured group time, and semi-structured play. Recordings were made in an unobtrusive manner, using a handheld video camera within a 5-metre radius of the target child/children. If approached by a child, the researcher responded in a neutral manner and encouraged the child to move on. At each visit, she collected 5-minute outdoor free-play samples for as many children with ASD as possible with in the available time (i.e. usually 3 children filmed per day). Sampling of individual children

during free-play was according to a pre-selected random order. If a child was absent on a given filming day, the researcher moved to the next child on the list. Filming continued in this way until five separate 5-minute free-play samples had been collected for each of the 13 children with ASD. At each visit, the researcher also collected footage of both the structured group time and semi-structured play session. During these activities, she orientated the camera in such a way as to capture the faces of as many of the participating children's as possible in any given moment, prioritising the children with ASD rather than their TD peers.

Free-play. The free-play condition occurred outside in a fenced playground area measuring approximately 40 square metres. The playground included a large sandpit, an in-ground trampoline, paved areas, open grass, climbing equipment, and ride-on toys. Staff were present to supervise the children and to help organise their play as necessary (e.g. suggesting activities when a child seemed lost), but they did not provide any specific teaching or support for peer-interaction. Once the TD boys had joined the ASD-specialist classroom, free-play occurred for approximately 15 minutes while teachers prepared structured group activities indoors. All children were then moved inside.

Structured group. The children were organised into three small groups in separate areas of the classroom. The children sat on individual plastic chairs arranged in a semicircle, facing the teacher. The two TD children joined the same group of four children with ASD (Sam, Mike, Amy, Chris) each day, and so it was this group which the researcher filmed. The structured group time lasted approximately 15-minutes, and included songs, games and routines aimed at supporting the children's development of social, communication, and literacy skills, according to the ASD-specific early intervention curriculum. A 5-minute sample of each session was selected for coding based on when the teacher started the first activity.

Semi-structured play. Following the structured group time, the children moved together to semi-structured play. The same small groups were maintained, moving to activity centres within the classroom (e.g. construction, dress-ups, toy kitchen/shopping) around rectangular tables with chairs. Teachers facilitated the children's interactions when necessary and offered suggestions for how to play, but did not dictate how the children should engage with the toys or one another. Again, a 5-minute sample of each session was selected for coding based on when all the children were seated in front of the activity table.

Coding procedure

Primary coding of all footage was conducted by a trained graduate research assistant, blind to the study aims and hypotheses, and to participants' diagnostic status. The research assistant watched each recording three times to complete the coding. On the first pass, she completed a frequency count of the child's *initiations* and *responses* to each available peer, based on definitions adopted from the Modified – Classroom Observation Schedule to Measure Intentional Communication [M-COSMIC; 3]. On the second pass, she used time stamping to code for the number of seconds in which the child engaged in *shared attention* with another peer, based on a code within the Dyadic Communication Measure for Autism [18], and she also completed a frequency count of instances of *positive affect* directed by the child with ASD toward a peer. On the third pass, she used a 10-second interval coding method to code for the proportion of time each child was engaged in each type of play (i.e. solitary, and parallel or interactive with a peer). The definitions for each dependent variable are provided in Appendix 1. In order to maintain blindness of the research assistant, she coded behaviours of the target child, delineating these by every individual peer to whom they were directed. The first author later aggregated scores across those peers known also to have ASD and across the two TD peers.

Reliability

Reliability coding was completed for a randomly selected 20% of all recordings. A single measures ICC was used to evaluate agreement, with all interaction codes demonstrating generally good to excellent agreement. Indices ranged from $r = 0.69$ to $r = 1.0$ ($M = 0.88$) in the free-play context and from $r = 0.77$ to $r = 1.00$ ($M = 0.93$) in the semi-structured play context, but were more variable for the structured group time, ranging from $r = 0.46$ to $r = 0.92$ ($M = 0.70$). Some coded behaviours arose infrequently, resulting in low ICC indices. Examination of scores of raw proportionate agreement suggested good to excellent reliability (specifically, *responses* toward TD peers, *shared attention* with TD peers, and the various play codes across each condition; ranging from 77% to 100% raw agreement).

Results

Part 1 – unstructured free-play

The aim of study Part 1 was to examine the way in which children with ASD interact together and with their TD peers, in a free-play context. First, we conducted a Friedman's ANOVA to determine whether the children with ASD, as a group, spent different amounts of time engaged in each type of play (i.e. solitary, parallel, interactive). This yielded a significant difference (χ^2 (2, $n = 13$) = 23.80, $p < 0.001$), with post-hoc inspection of median values indicating most time spent in solitary play ($Md = 712.50$ seconds), followed by parallel play ($Md = 60.00$ seconds), with least time in interactive play with another child ($Md = 1.25$ seconds). Using a paired-samples t-test, we then examined whether the time children with ASD did spend in parallel play was evenly distributed across peers with ASD and TD, with no such difference apparent (t (12) = -1.41, $p = 0.18$, two-tailed). A similar comparison for interactive play was undertaken using a Wilcoxon signed ranks test (due to non-normal

distribution of these data). Here, children with ASD were found to have spent significantly more time in interactive play with peers with ASD compared to with TD peers (z = -2.01, p = 0.04) with a medium effect size (r = 0.39). Figure 1 illustrates the average amount of time, per 5-minute free-play sample, spent by the children with ASD engaged in each type of play with each type of peer.

Insert Figure 1 here

Additional analyses were conducted to investigate the above after the proportion of available TD peers (i.e. n = 2) and peers with ASD (i.e. n = 12) was considered. New play variables were created, taking into account the proportion of peers available of a given type (TD or ASD), The paired-samples t-test revealed a significant effect (t (12) = 2.92, p = 0.01, two-tailed) for parallel play, such that children with ASD spent relatively more time in this type of play with TD peers (M = 43.85, SD = 41.85), than with peers with ASD (M = 11.17, SD = 9.18), given the numbers available. The mean difference in time spent in parallel play with each peer type was 32.68 seconds (95%CI = 8.31 - 57.03), with the eta squared statistic (0.41) indicating a large effect size. A similar analysis revealed no significant differences for interactive play, given the available number of each type of peer (z = -.17, p = 0.86). The median time spent in interactive play per available TD peer (Md = 0.00) was not significantly different from that per available peer with ASD (Md = 1.25). Figure 2 illustrates the average time per 5-minute free-play sample, spent by the children with ASD engaged in each type of play with each type of peer, as a function of the number of available partners in that group.

Insert Figure 2 about here

We used four separate Wilcoxon tests to test the hypothesis that children with ASD would *initiate* and *respond* more often toward, *share attention* with for longer, and direct *positive affect* more often toward TD peers than with peers with ASD, during unstructured free-play. There was no significant difference in initiation frequency (z = -0.84, p = 0.40),

with a median of only one initiation bid made toward each of the TD peers and peers with

ASD per session. Similarly, there was no significant difference in response frequency ($z = -0.37$, $p = 0.72$, $Md = 0$), duration of shared attention ($z = -0.81$, $p = 0.42$, $Md = 0$), or positive

affect ($z = -1.34$, $p = 0.18$, $Md = 0$) directed toward different peer types during free-play time.

Table 2 presents descriptive data for the social play and social-communication scores of

children with ASD during free-play.

Insert Table 2 about here

Again, we conducted additional analyses to investigate whether a different pattern

would arise if the proportion of available TD peers (i.e. $n = 2$) and peers with ASD (i.e. $n = 12$) were considered. New social play variables were created, taking into account the

available number of each peer type. No significant difference in frequency of initiations was

evident, after accounting for the number of available peers of each type ($z = -1.79$, $p = 0.07$).

However, the median score for initiation toward TD peers ($Md = 0.50$) was somewhat greater,

given the small number present in the playgroup, than that toward peers with ASD ($Md = 0.08$) who were much more numerous. No significant differences were found for response

frequency ($z = -1.82$, $p = 0.07$), duration of shared attention ($z = -1.58$, $p = 0.11$), or frequency

of positive affect ($z = -1.60$, $p = 0.11$), with median scores of 0 for each variable.

Part 2 – Structured Group Time and Semi-Structured Play

The aim of study Part 2 was to examine differences in the way children with ASD

interacted with one another and with their TD peers, across two contexts involving teacher

facilitation; structured group time and semi-structured play contexts. Four of the children

with ASD and the two peers with TD from Part 1 were included here, due to the way in which

the early intervention classroom was organised during this part of the day's activities. Due to

absences, the total number of video samples captured differed for each child (Sam = 10, Mike

= 12, Amy = 8, Chris = 4). The small sample limits our analysis to descriptive statistics and

visual inspection of trends in the data.

We first examined differences in the way the children with ASD interacted with their peers with ASD and TD peers within each context (structured vs. semi-structured activities), on a session-by-session basis, as illustrated in Figure 3. Irrespective of context, we expected the children with ASD to interact more frequently with TD peers than with peers with ASD. Therefore, we determined the number of sessions in which each target child demonstrated greater frequency of a given behaviour toward peers of one type or the other (i.e. TD vs. ASD). We excluded tied sessions in which the behaviour was directed equally frequently to both peer-group types, and then computed the proportionate number of sessions in which more of the behaviour was observed toward peers with ASD compared to TD peers (i.e. ASD majority/TD majority). To illustrate, in Sam's interactions with peers during the structured context, he initiated more frequently toward TD peers in 4 sessions, more frequently toward peers with ASD in 4 sessions, and equally frequently to both peer types in 2 sessions. Therefore, he displayed no overall bias in his initiations toward either peer-group type across the non-tied sessions (4/4 = 50%). This pattern for Sam was also evident within the semi-structured context, with no overall bias observed towards one peer group or the over.

Insert Figure 3 about here

Continuing with initiations, Mike was observed to initiate equally to both groups of peers in the structured context. However, he displayed bias to initiating more towards peers with ASD in the semi-structured context, doing so in 3 out of 4 (75%) non-tied sessions. Amy and Chris both displayed bias to initiating toward peers with ASD in the structured context, doing so during 75% and 100% (respectively) of non-tied sessions. However, they displayed the opposite pattern of initiations during the semi-structured context, doing so more toward TD peers on 100% of non-tied sessions. Overall, therefore, 2 of the 4 children with ASD demonstrated initiation bias toward peers with ASD across structured context sessions,

whereas in the semi-structured context, one child displayed no particular bias, one child initiated more frequently to children with ASD, and two children initiated more frequently to TD children.

The children with ASD were expected to respond more often toward TD peers than toward peers with ASD, irrespective of context. As illustrated in Figure 4, only two children with ASD were observed to respond to their peers at all during the structured context. When these instances occurred (Amy in session 7 and Chris in session 4), they were both directed toward children with ASD. In the semi-structured context, Sam directed his responses to peers with ASD in 3 of 4 non-tied sessions (75%), while Mike did so in all 3 of his non-tied sessions (100%). Neither Amy nor Chris responded to a peer of any type during the semi-structured activities.

Insert Figure 4 about here

Irrespective of context, the children with ASD were also expected to engage in longer cumulative durations of shared attention with TD peers than peers with ASD. As illustrated in Figure 5, a great deal of variability was observed. Sam displayed more shared attention with TD peers on 2 out of 3 (66%) sessions in which some shared attention was observed. In contrast, Mike, Amy, and Chris displayed more shared attention to peers with ASD on 66%, 100%, and 100% (respectively) of non-tied sessions. In the semi-structured context, the opposite pattern was observed. Sam, Mike, and Amy shared more attention with TD peers on 62.5%, 60%, and 66% (respectively) of non-tied sessions. Chris, however, shared more attention with peers with ASD on both of his non-tied sessions (i.e. 100%).

Insert Figure 5 about here

Children with ASD were expected to direct positive affect more often toward TD

peers than toward peers with ASD. In the structured context, Sam and Amy directed more positive affect toward peers with ASD than TD peers in 60% and 100% (respectively) of non-tied sessions, while Mike directed more positive affect toward TD peers on 2 of the 3 non-tied sessions. Only Sam and Mike were observed to direct any positive affect in the semi-structured context. On the single occasion that Sam did so, it was toward a peer with ASD. Mike directed positive affect on 4 different occasions, divided evenly toward peers with ASD and TD. The children's frequency of directing positive affect towards peers is illustrated in Figure 6.

Insert figure 6 about here

Finally, to explore the possible influence of context (structured versus semi-structured) on peer interactions, we looked at each child's *initiations, responses, shared attention,* and *positive affect* toward any other peer in each context. Due to the variability in children's production of the target behaviours across contexts and over time, calculations here were based on average rates of interaction across all available sessions. As presented in Table 3, a trend towards greater production of target behaviours in semi-structured contexts was observed. Indeed, of the 25 variables (i.e. initiations, responses, shared attention, positive affect) across participants, for which a structured vs. semi-structured comparison could be made, (i.e. at least one score greater than zero), 18 (72%) favoured the semi-structured context.

Insert Table 3 about here

To further investigate the possible influence of context on the social-communication behaviours of children with ASD toward others, irrespective of peer type, we conducted paired-samples t-tests comparing rates/durations of each measure across structured and semi-structured contexts. As illustrated in Figure 7, children with ASD initiated more frequently

during the semi-structured context ($M = 3.42$) compared to during the structured context ($M = 1.99$, $t(3) = -1.91$, $p = 0.15$, two-tailed). The amount of shared attention between the children with ASD and any of their peers was approximately six times greater during the semi-structured ($M = 20.40$) compared to the structured context ($M = 3.02$, $t(3) = -2.60$, $p = 0.08$, two tailed). Children with ASD rarely directed any positive affect toward peers, under either condition during the structured condition ($M = 0.22$) or the semi-structured condition ($M = 0.17$, $t(3) = 0.52$, $p = 0.64$, two tailed).

Insert Figure 7 about here

Discussion

The aim of this study was to examine possible differences in the frequency and quality of interactions between children with ASD and their peers with ASD and TD peers when brought together as part of a reverse inclusion program. We did so by carefully observing the children's social-communicative behaviours – frequencies of initiation and response act, duration of engagement in shared attention with, and frequency of positive affect directed toward peers with ASD and TD – in each of three interaction contexts. The results reveal a great deal of variability among children with ASD, in different contexts, and across individual observation sessions. Although limited by the scope of the study, the current findings point to trends in the ways in which children with ASD interact with their peers and highlight the need for better understanding of the difficulties they face so that these may be addressed within early intervention programs.

Interactions during free-play

A concerning finding of the current study was that children with ASD spent the vast majority of their time engaged in solitary play, when left to their own devices in the context of unstructured outdoor free-play in an early intervention setting. This is perhaps not surprising, given the inherent social- communication and behavioural difficulties experienced

by children with ASD, and is consistent with the findings of previous research [e.g. 13].

However, this points to the need to provide adequate support to children with ASD across all

contexts in early intervention settings, if they are to engage in frequent and successful peer

interactions. In addition, the findings suggest that simply bringing TD peers into an early

intervention playground, as part of a reverse inclusion program, without specific support or

strategies, is unlikely to impact substantively on the play and interaction experiences of

children with ASD.

We expected that when the children with ASD did engage in parallel or interactive

play (albeit it infrequently), this would tend to be with TD peers rather than with peers with

ASD. However, the current results were mixed. When we examined with whom the children

with ASD interacted at a raw level, we found they engaged significantly more often with

peers with ASD than with the TD peers who had joined the playground for the morning

session. However, when we accounted for the number of available partners of each peer type

(12 ASD versus 2 TD), the result was no longer significant for interactive play, but was now

significant for parallel play. That is, when the children with ASD engaged in parallel play, it

was more often alongside the TD peers, relative to the small number available and despite the

large number of peers with ASD available. However, when it came to examining differences

in the children's initiations and responses, shared attention, and positive affect towards peers,

we found no significant differences based on peer type, whether or not we accounted for the

available number of each.

Interactions during structured group time and semi-structured play

We expected children with ASD to initiate and respond more often, share attention for

longer periods with, and direct positive affect more frequently toward TD peers than peers

with ASD. However, for 7 of the 8 variables (i.e. initiations, responses, shared attention, and

positive affect across the structured and semi-structured contexts) for which a trend was

identified, it was indicative of greater interaction toward peers with ASD, rather than toward TD peers. Nevertheless, caution is required in interpreting this finding, given the small sample size, the substantial individual variability observed among our four target children with ASD, and the fact that their rates of interaction were generally low. Specifically, comparisons by peer type that have been drawn on the basis of comparing two very low rates of interaction can only be viewed as yielding preliminary evidence to a given position, requiring future replication (e.g. Amy being judged to direct more positive affect toward peers with ASD on the basis of her doing so *once* toward another child with ASD, and never toward a TD peer, across eight sessions).

What works best to facilitate interaction?

In moving from outdoor free-play, to structured or semi-structured contexts, the key difference is in the amount of support provided by teachers. We found that the children with ASD initiated more often, and shared attention for longer periods of time with their peers (of any type) during semi-structured settings, compared to structured group time. This finding contrasts with that of Jenkins et al. [14], who reported that children with developmental disabilities tend to interact more with one another in structured play contexts than in semi-structured contexts. However, this difference may be explained by several factors. Firstly, given that 'structured' and 'semi-structured' contexts differ across studies, any differences in performance may simply reflect methodological variation. Secondly, Kok, Kong and Bernard-Opitz [19] reported that more verbal and cognitively able children with ASD tend to initiate play more often during facilitative semi-structured settings than children who are less verbal and cognitively able. Therefore, characteristics of each child may, in part, determine whether he or she is likely to interact more frequently with peers in more or less structured contexts. Future studies involving larger samples of children are needed in order to allow for sub-group analysis of interaction patterns with reference to child-related characteristics.

In considering the influence of context, the fact that the children tended to interact most frequently with peers in the semi-structured play activity, less frequently in the structured group activity, and rarely at all in the unstructured free-play highlights the importance of creating a variety of learning contexts in early intervention classrooms. Specifically, structured contexts may be suited to achieving individual educational goals, whereas semi-structured settings may be superior for supporting learning through peer interaction. Free-play, on the other hand, is arguably the best context in which to observe the generalised effects of intervention aimed at increasing peer interactions, which should ultimately continue in the absence of adult facilitation. However, our preliminary findings indicate that free play is not an ideal context in which to implement unsupported reverse inclusion, bringing TD children into ASD-specific early intervention settings, if the goal is to increase the frequency and improve the quality of peer interactions.

Study limitations and future directions

The current findings need to be considered with reference to the limited scope of the study. We focused our attention on a small group of well-characterised participants using systematic observational sampling of naturalistic behaviour within a group-based early intervention centre. This therefore allowed the detailed examination of interaction patterns across three different contexts and various important facets of social-interaction skill. However, the small sample may have limited our ability to detect clinically and statistically significant differences in the way the children with ASD interact with one another and with their TD peers. Further studies, involving larger samples and/or experimental manipulation of the variables of interest (i.e. presence of peers with and without ASD) would advance our understanding of the issues presented here.

From a clinical perspective, it could be argued that because the children's rates of

social-communication and interactive play behaviours were low in the present study, drawing conclusions regarding differences in their interactions with one type of peer over another is not meaningful. That is, if a child makes one initiation to a TD peer across 5 minutes of free play and 2 initiations to a peer with ASD over the same period, is this really significant? Clearly, further research is needed to better understand any group differences that may exist. However given that these are core social-communicative symptoms of ASD, investigation of their moderators and mediators is important even if occurrence is only at low-frequencies. An increase from one to two instances of a given interaction behaviour, per 5-minutes of opportunity to interact, is functionally meaningful and positive, if still presenting a low base-rate.

Our findings do, however, also point to the need for research examining peer interactions to move beyond frequency counts and duration measures, to take a more fine-grained look at the antecedents to interactions, the form and function of communicative attempts, and the reactions of communication partners that may serve to maintain, promote, or inhibit further interaction [e.g. 20]. Further research is also needed to examine the extent to which children's rates of interaction during unstructured free-play time can be increased through teacher support or peer-mediated intervention, and the level of structure required to effect such an increase. Such research would help elucidate whether rates of engagement in solitary play are a reflection of the level of teacher support, the diagnostic status and skills of the child and available peer/s, or a combination of all of these factors.

Conclusion

A key aim of early intervention programs is to help children with ASD to increase the frequency and quality of their interactions with peers. Yet despite concerted efforts to develop and evaluate adult-mediated and peer-mediated strategies to address this need, few studies have examined the actual nature of peer interactions involving children with ASD. Our aim

was to examine possible differences in the frequency and quality of interactions of children

with ASD among one another and with their TD peers in the context of a reverse inclusion

program embedded within a community-based early intervention service. The results

highlight the significant individual variability present, even within a small group of children

with ASD attending the same targeted early intervention service, and highlight the need to

tailor learning supports to the needs of individuals. The results also make a modest

contribution to the emerging evidence for the influence of different levels of structure (e.g.

teacher support) on the peer interactions of children with ASD.

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Declaration of interest

The authors have no conflicts of interest to report. The authors alone are responsible for the

content and writing of the paper.

Appendix

Operational Definitions of Target Behaviours

From the M-COSMIC (Clifford et al., 2010)	
Initiations	Initiations are coded when the child spontaneously initiates an interaction. This can be through statements and gestures toward a peer, or when a response provides a clear elaboration, contradiction or correction of a previous statement *(e.g. Peer says, "There's your shoes!", target child responds, "They're not my shoes; these are my shoes!!" pointing to a different pair of shoes).* Initiations are not coded when the peer clearly prompted the interaction verbally, physically, or otherwise. The number of initiation acts is totalled across the sampling period for an overall frequency count.
Responses	Responses are coded when the child responds to a peer's instruction, prompt, question, suggestion, or action *(e.g. the child stands after being told "stand")*, even if the child's response is incorrect. Responses can include compliant or cooperative positive responses, displayed by continuing interaction which complies with verbal or nonverbal requests. Alternatively, responses can also be noncompliant or aggressive negative responses, displayed by actively refusing to act in accordance with requests. The number of response acts is totalled across the sampling period for an overall frequency count.
From the DCMA (Hudry et al., in preparation)	

Shared attention	Shared attention is coded when an episode of engagement involving the child and a peer occurs, as evidenced by mutually gaze toward one another, or toward a common object or event. This can be achieved through full gaze, pointing or other verbal or nonverbal gestures and is only coded if each child is aware they are sharing attention with the other. Shared attention is time-stamped for its initiation and termination, with the duration of each episode then computed and summed across the observation period to form a cumulative duration code. Sustained shared attention is coded and summed, rather than fleeting episodes of joint attention.
Novel Codes	
Positive affect	Positive affect is coded when the target child produces a laugh, smile, or other sign of enjoyment, either before or immediately after gazing toward a peer. It is coded if the mouth is observable and the expression in the child is a positive one (i.e. joy, excitement or fun) and there is a sense that the affect is distinguished from the child's overall emotional state (i.e. a specific instance of positive affect, not a general positive mood). The positive affect does not need to be reciprocated by the partner. This novel code was based on the ADOS-G (Lord et al. 2000) code for Shared Enjoyment, but coded using a method similar to the M-COSMIC frequency counts for initiation and response.
Solitary play	Solitary play is coded if the target child is isolated from the common play area, wanders without noticing peers, obtains visual or auditory information/stimulation from toys or objects when alone,

	and/or is within physical proximity of peer/s but does not interact with them in any way. Coding is by 10-second interval, with solitary, parallel and interactive play types mutually-exclusive. The most sophisticated play type observed within a given interval is coded.
Parallel play	Parallel play is coded when the target child is watching a peer but does not interact in a play activity with that peer, when independent play brings the child closer to a peer, when plays beside a peer (but not with that peer), and when the child makes no attempt to modify, influence or control the activity of the peer. Coding is as described above (see Solitary Play).
Interactive play	Interactive play is coded when the target child actively plays and engages with one or more peers and there is an exchange of materials/toys, the child directs the activities of the peer/s, and/or the play is goal driven or supplements/supports the efforts of the partner. Coding is as described above (see Solitary Play).

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Figures

Figures

Figure 1. Average time spent by children with ASD (+SE), per 5-minute free-play sample, engaged in solitary play (n = 12), and in parallel (n = 12) and interactive play (n = 12) types with TD peers and peers with ASD.
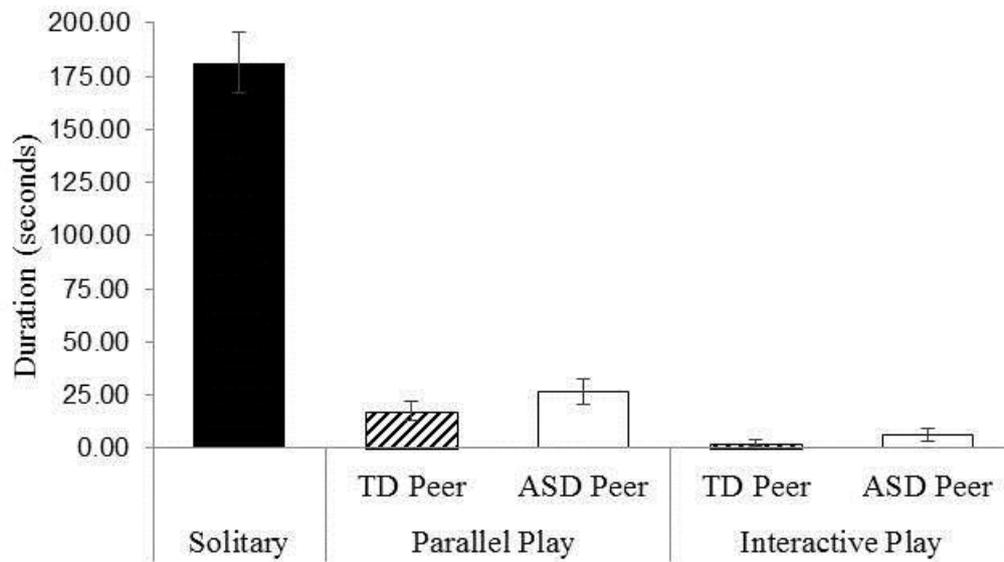
Figure 2. Average time spent by children with ASD (+SE), per 5-minute free-play sample,

engaged in parallel (n = 12) and interactive play (n = 12) types with TD peers and peers with

ASD, as a function of the available number of each partner type.
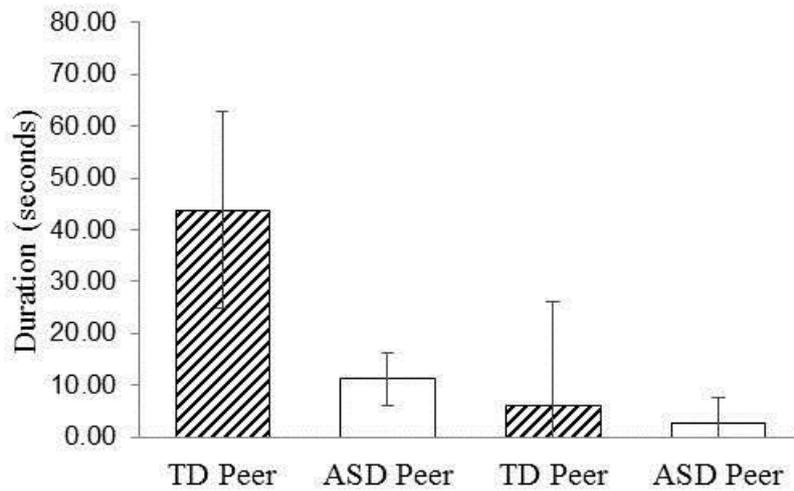
Figure 3. Frequency of initiations produced by each target child with ASD, per 5-minute

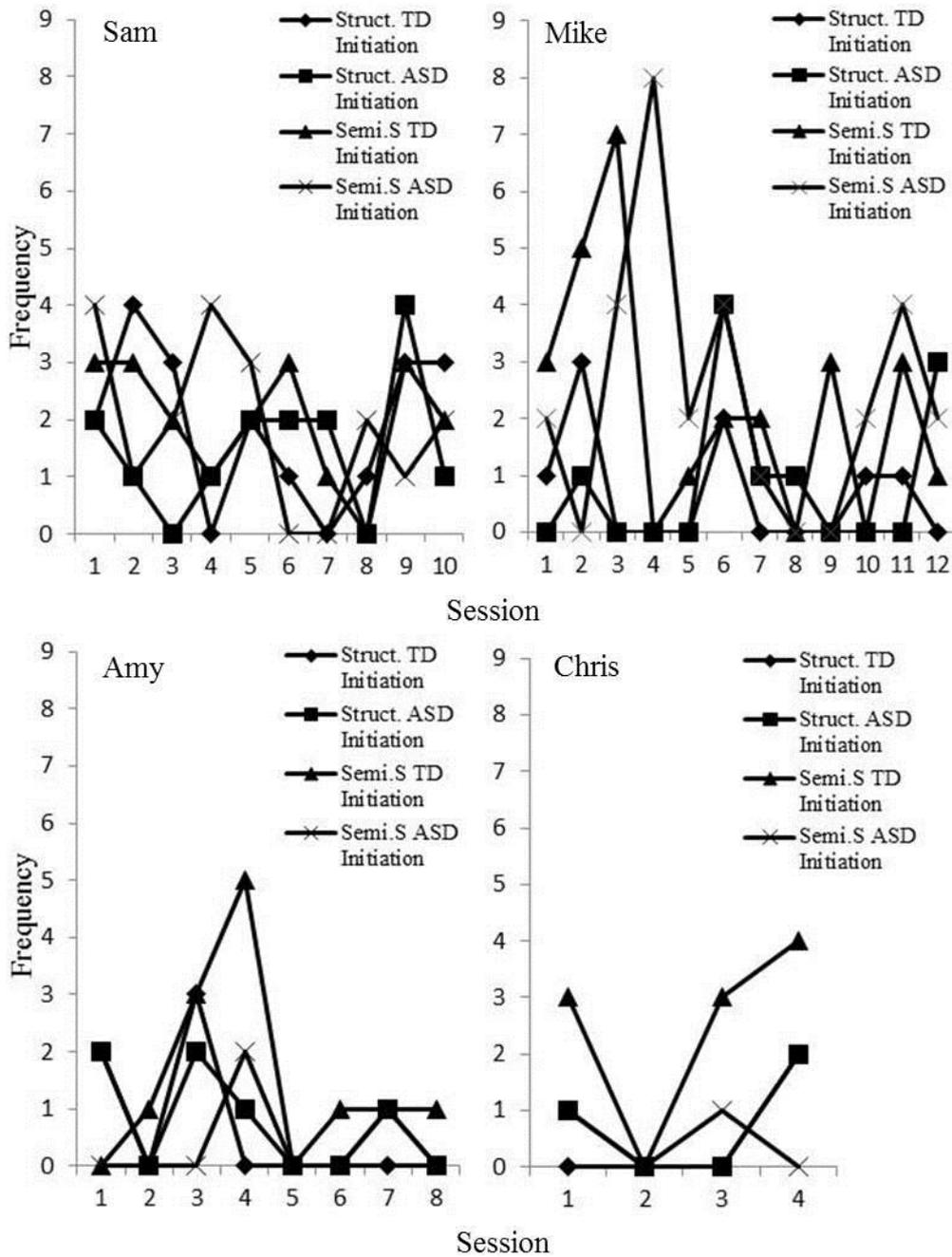structured and semi-structured context sample, toward a TD peer or peer with ASD.

Figure 4. Frequency of response behaviours per 5-minute session during structured and semi-structured settings produced by children with ASD toward TD peer or peer with ASD.
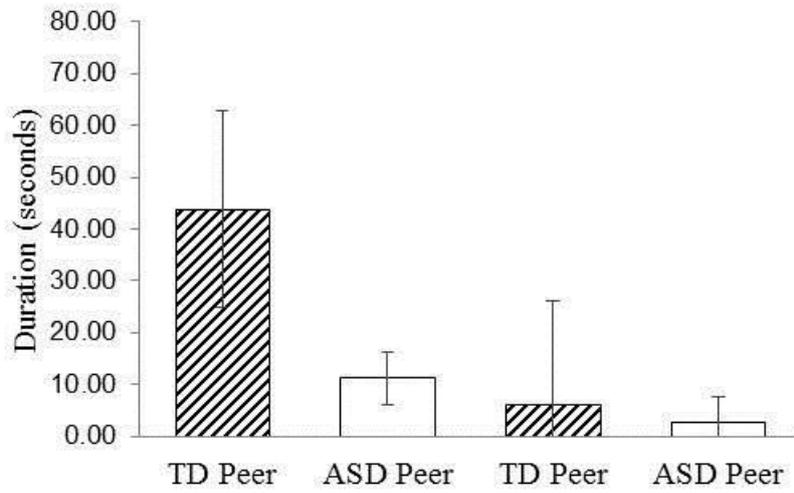
zigure 5. Duration in minutes of shared attention per 5-minute session of structured and semi-

structured settings produced by children with ASD toward TD peers and peers with ASD.
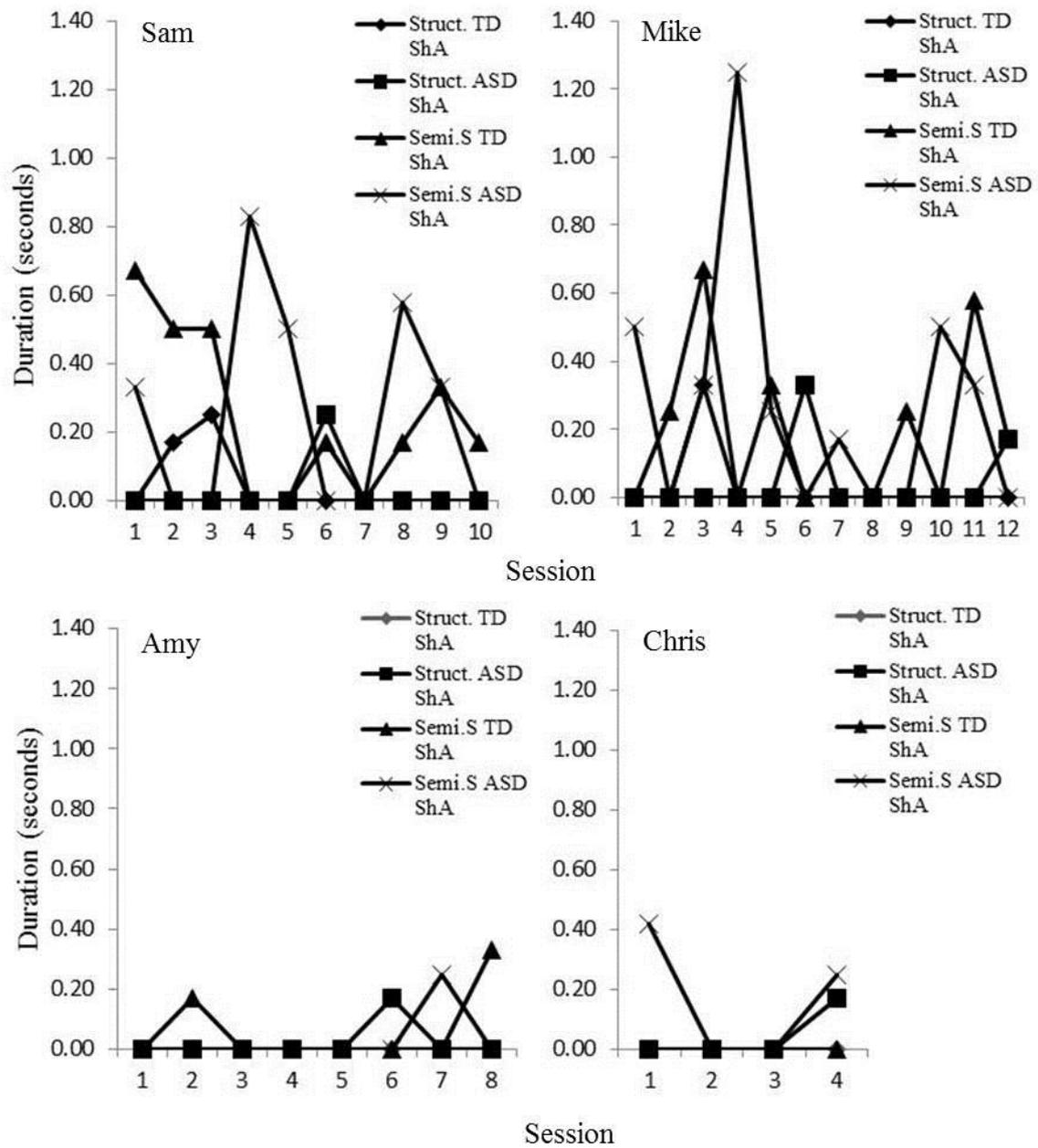
Figure 6. Frequency of shared positive affect per 5-minute session of structured and semi-structured settings produced by children with ASD toward TD peers and peers with ASD.
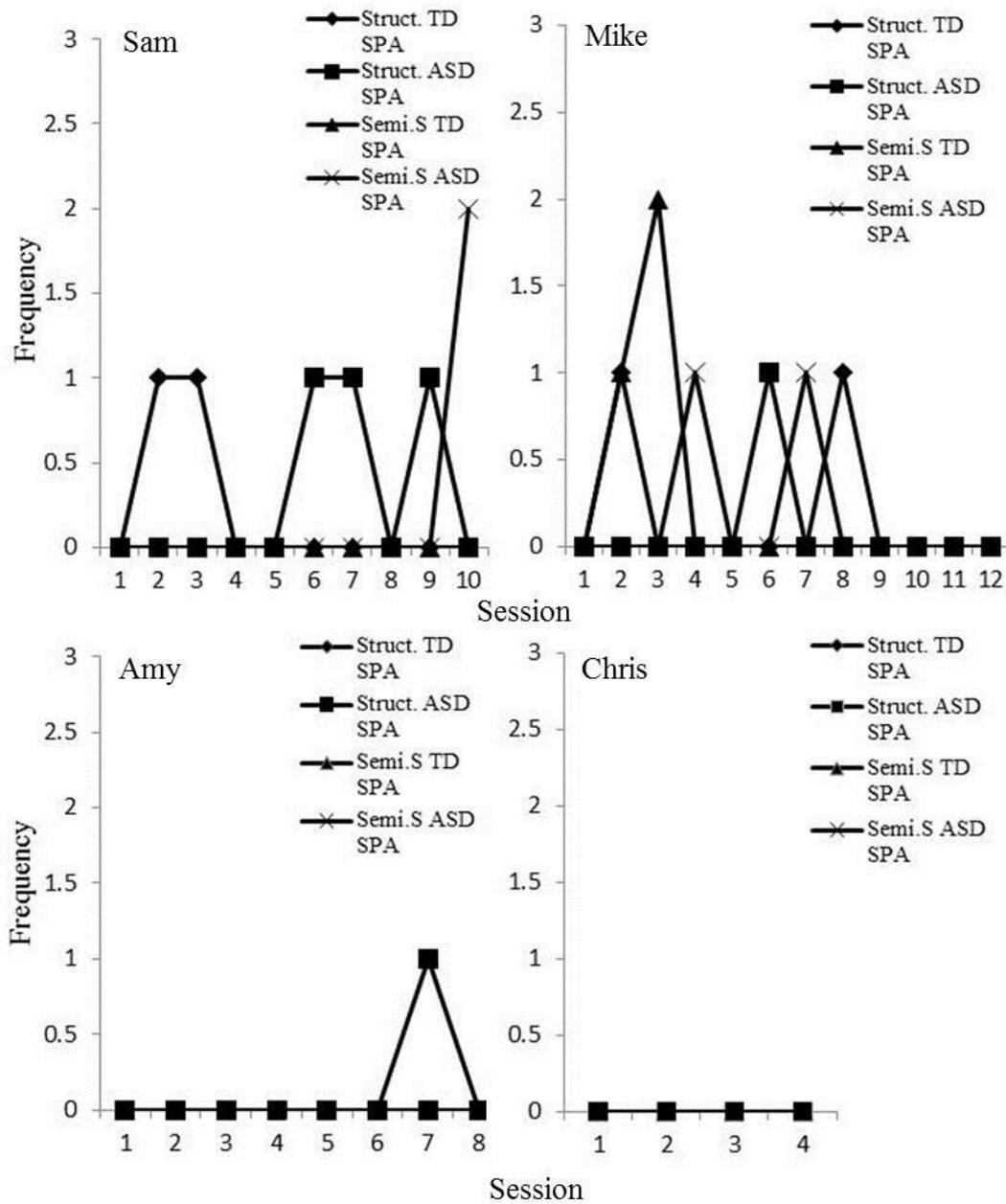
Figure 7. Total frequency of initiations, responses and shared positive affect. Total duration

in seconds spent in shared attention with any peer (TD and ASD combined), across structured

and semi-structured settings over total number of observations of children with ASD com-

bined. *Note.* Init. ANY = Initiation to any peer; Resp. ANY = Response to any peer; SPA.

ANY = Shared positive affect to any peer.

Social-communication variable