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Preschool Based JASPER Intervention in Minimally Verbal Children with Autism: Pilot RCT

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Abstract

In this pilot study, we tested the effects of a novel intervention (JASPER, Joint Attention Symbolic Play Engagement and Regulation) on three to 5 year old, minimally verbal children with autism who were attending a non-public preschool. Participants were randomized to a control group (treatment as usual, 30 h of ABA-based therapy per week) or a treatment group (substitution of 30 min of JASPER treatment, twice weekly for regular program). A baseline of 3 months in which no changes were noted in core deficits was followed by 10 weeks of intervention for children randomized to the JASPER treatment. Participants in the treatment group demonstrated greater play diversity on a standardized assessment. Effects also generalized to the classroom, where participants in the treatment group initiated more gestures and spent less time unengaged. These results provide further support that even brief, targeted interventions on joint attention and play can improve core deficits in minimally verbal children with ASD.

Keywords

Autism; Minimally verbal; Intervention

Children with an autism spectrum disorder (ASD) are a phenotypically heterogeneous group. Many of the children have limited spoken language at the time of diagnosis. The majority will go on to use spoken language by the time they enter school at age five. Some children, approximately 25–30 % gain very little spoken language during the pre-school years, and for these children targeted and novel interventions are likely needed. For example, in one study of 84 children with autism who were followed from 2 years of age nearly 30 % of the children had no or few consistent words at age 9 years (Anderson et al.

2007). These findings were noted despite the fact that children were in intensive behavioral interventions from a young age.

Using spoken language by age 5 years remains the most important goal of early intervention as these children are found to have the best social outcomes (Billstedt et al. 2007; Rutter 1978). There is evidence that children who show more initiating joint attention skills have better spoken language skills later (Dawson et al. 2004; Mundy et al. 1990), and that interventions that teach these skills can improve spoken language outcomes (Kasari et al. 2008, 2012). Other social communication skills (e.g., requesting and responding to joint attention) are easier to improve, and may also have positive effects on child outcome. Responding to joint attention (e.g., following a point to a picture) predicts pre-school children's language outcome 8 years later (Sigman and Ruskin 1999), and a summary variable of all social communication gesture use (behavior regulation and joint attention gestures, responding and initiating) also predicts better outcomes (Charman et al. 2005; Watt et al. 2006).

Although significant progress has been made in identifying core features of autism and developing effective interventions for preschool-age children with this disorder, these efforts have generally overlooked children who do not make significant progress in spoken communication, and children who are the most developmentally impaired. Studies usually require children to have a certain developmental age or IQ prior to entry into an intervention trial (Dawson et al. 2009; Landa et al. 2011; Lovaas 1987; Smith et al. 2000). Therefore, we know little about how the children with the most significant impairments can change using specific and novel intervention approaches.

Interventions that are implemented for preschool children with autism commonly use applied behavior analysis approaches to teach children. While many children make remarkable gains in social and communication skills, others make slow or limited progress. For children who do not make progress with the usual curriculum, a focus on these core areas (engagement, play, and social communication) may be even more important. Therefore, limiting the sample to children who do not make progress may give us more information on what is possible in addressing core deficits of joint attention and play diversity.

The goal of the current study was to test whether an intervention focused on a developmentally based approach for teaching joint engagement, joint attention, and play skills could improve social communication outcomes in children who traditionally have been excluded from intervention trials. Children who participated in the study were diagnosed with autism, were currently in intensive 30-h per week ABA-based interventions for at least 1 year, and could say fewer than 10 spontaneous, functional words. The goal was to determine if a brief intervention (24 sessions over 3 months) could significantly improve children's social communication skills on independent assessments, and when observed in their classroom.

Method

Participants

A total of fifteen preschool aged children with autism were recruited from a non-public autism specialty school from 2008–2010. All of the participants received a minimum of 30 h per week of behaviorally based interventions, as well as speech and occupational therapies. Participants were included in the present study if they were between three and 5 years old, had a clinical diagnosis of autism, attended the non-public school, and used less than ten spontaneous, functional and communicative words by parent and teacher report and during the baseline or entry assessments (assessments described below).

The university's Internal Review Board approved the study. Recruitment fliers were handed out at the school. Parents who were interested in the study contacted the study staff directly to complete an initial phone screen. Parents who were interested were sent consent forms that were signed prior to beginning the study protocol.

The sample was diverse with over half of the children identified as African-American, Hispanic, or Asian. The average chronological age of the participants was 51.9 months, mental age was 15.45 months, and developmental quotient was 31.81 (see Table 1).

Procedure

Participants completed a series of baseline assessments prior to study entry (see Fig. 1). All participants were assessed again 3 months later at entry, to verify stability in skills that would be the target of the intervention (play and social communication gestures). After completion of the entry assessments, participants were randomly assigned to either the Treatment or Control group. Group assignment was completed using a block randomization to ensure that there was a manageable caseload of treatment versus control participants at a given time (see Fig. 1 for more detail). The randomization was completed using a random number generator in SPSS. The treatment phase lasted three months, and was followed by exit assessments.

Participants assigned to the Control Group received the regular school program for 30 h per week. Participants in the Treatment group were pulled out from the same classrooms as the Control group for 30-minute sessions, twice a week for 12 weeks, to work with study personnel on communicative gestures in a play-based treatment, JASPER (joint attention symbolic play engagement and regulation; see Kasari et al. 2006; 2010 for more detail on intervention content). The study interventionists were graduate students in educational psychology, experienced in intervention with young children with autism. Fidelity was rated on sessions, with an average rating of 88.27 % ($SD = 5.75$, range 80–100 %). Based on the entry assessments, individual levels of play and joint attention and/or requesting gestures were identified as mastered or emerging. Study personnel used toys that represented the child's interests within their mastered and emerging play levels. Most participants were at a requesting level of gesture use. Interventionists used the toys to help the child create play routines that would facilitate joint engagement (reciprocal interaction between interventionist and child around an activity; i.e., play routine). Opportunities were embedded within the play routines to elicit the targeted communication skill; this included waiting

before performing steps of a routine, expanding play within routines, and using balanced turns.

Measures

Standardized Assessments—Diagnosis of autism was confirmed for each child at baseline using the autism diagnostic observation scale (ADOS, Lord et al. 2000). The mullen scales of early learning (MSEL; Mullen 1997) was used at baseline to assess mental age (MA) and developmental quotient (DQ), as well as four subscales of development: Visual Reception (VR), Fine Motor (FM), Receptive Language (RL), and Expressive Language (EL). The reynell developmental language scales (RDLs; Reynell 1977) was used at base-line and exit to assess each participant's verbal comprehension (VC) and expressive language (EL). Assessments were completed by assessors blind to treatment condition.

Structured Play Assessment (SPA)—The Structured Play Assessment is an experimental measure of play, completed with an independent assessor (Ungerer and Sigman 1984). The structured play assessment was completed at Baseline, entry, and exit. The assessment is later coded for play types, a measure of play diversity which sums the number of unique spontaneous and functional play acts (Lifter et al. 1993). Inter-rater reliability using intra-class correlation coefficient (*ICC*) was 0.84.

Early Social Communication Scales (ESCS)—The ESCS is a semi-standard assessment, conducted by blind assessors, designed to elicit spontaneous joint attention (IJA) and requesting (IBR) gestures from the participants (Mundy et al. 1996, 2003). The ESCS was completed at baseline, entry, and exit. Only spontaneous gestures were coded. Reliability was measured using single measures *ICC* for the composite variables: IJA (*ICC* = 0.85), IBR (*ICC* = 0.85).

Classroom Observation Measure (Class Obs)—The classroom observation measure (Wong and Kasari 2012) was designed to observe engagement states (Adamson and Bakeman 1985) and spontaneous communicative gestures during 20 min of free play in the classroom, with the child's classroom teacher and/or aides at Entry and Exit (Mundy et al. 1996; Mundy et al. 2003). Engagement states were coded as unengaged, object, onlooking, person, supported joint, or coordinated joint engagement (Adamson and Bakeman 1985). Interval coding was used for the engagement states by blind coders; observing for 50 s and coding for 10 s. Communicative gestures (coordinated joint looks, points, gives, and shows) were tallied and identified as being used for requesting (IBR) or for joint attention (IJA). Reliability was analyzed for engagement state (*ICC* = 0.92) and child gestures (*ICC* = 0.74). The variables used for the present study was the total frequency of spontaneous gestures and the percentage of time participants were in an unengaged state.

Results

Analytic Strategy

Due to the small sample size ($n = 15$ at Baseline and Entry, $n = 11$ at Exit), non-parametric statistics were used. First, we assessed whether there were any initial differences between

groups at the baseline or entry time points with the Kruskal–Wallis test. Then, we tested whether the participants were making significant change on the variables from baseline to entry time points with the Wilcoxon signed-ranks test. Next, we used the Kruskal–Wallis test to analyze group differences at Exit, as well as the effect size (Cohen's $d = M_1 - M_2 / s_{\text{pooled}}$). To assess whether the treatment group had made significant change from entry to exit, we used the Wilcoxon signed-rank test as well as calculated the reliable change index,

using the formula: $SE_{\text{Diff}} = SD_1 * \sqrt{2 * \sqrt{1 - r}}$ to calculate the standard error of the difference for each variable (Jacobson and Truax 1991; Evans et al. 1998).

Baseline and Entry characteristics

Developmental and demographic information is presented in Table 1. First, we used the Kruskal Walls test to ensure that there were no differences between the two groups prior to treatment, at baseline and entry time points (Treatment group $n = 7$, Control Group $n = 8$). There were no statistically significant differences between the groups at baseline or entry on the outcome or developmental variables (Table 2). Effect sizes were calculated, by group, for the outcome variables at entry. While there was no effect of group on play diversity ($d = 0.13$), there was a moderate effect of group on time unengaged ($d = 0.49$) and a large effect of group on initiated requesting gestures ($d = 1.01$) at entry.

Change from Baseline to Entry

We used a Wilcoxon signed-ranks test to assess significant change from the baseline to entry time point (Treatment group $n = 7$, control group $n = 8$). Overall, participants demonstrated a statistically significant *decrease* in their play types on the SPA using a Wilcoxon signed-ranks test ($z = -2.74$, $p = 0.01$) but did not demonstrate significant change on the ESCS (Table 3).

Group Differences at Exit

To test for group differences at exit, we used the Kruskal–Wallis test (Table 2). For diversity of spontaneous play, the Treatment ($n = 5$) and Control ($n = 6$) groups were significantly different, $H(1, N = 11) = 4.09$, $p = 0.04$. The effect size for play diversity was $d = 0.81$, indicating a large effect. During the TCX, participants in the treatment group spent less time unengaged $H(1, N = 11) = 3.87$, $p = 0.05$. The effect size for percent time unengaged was $d = 1.63$, a large effect. Participants in the treatment group initiated more requesting gestures at exit $H(1, N = 11) = 6.61$, $p = 0.01$. The effect size of treatment group on requesting gestures was $d = 1.51$, also a large effect. There were no significant differences on the ESCS variables (IJA and IBR).

Change from Entry to Exit by Group

To assess change from entry to exit on the control and treatment groups separately, the Wilcoxon signed-rank test was used (Table 3). The Control group did not have significant change on any of the outcome variables. Next, we investigated change in the treatment group. First, we found a significant increase in play types ($z = -2.03$, $p = 0.04$). The RCI yielded a SE_{Diff} of 3.71, suggesting that 80 % of the participants had reliable increases from entry to exit. Next, we looked at percent time unengaged and found a significant decrease

for the treatment group ($z = -2.02, p = 0.04$). Using the RCI, the SE_{Diff} for percent time unengaged was 8.80 and 80 % of the treatment group reliably decreased in their time unengaged. Last, we tested the frequency of requesting gestures used during the TCX. We did not find a significant change in IBR ($p = 0.22$). The RCI yielded SE_{Diff} of 1.31 with only 40 % of the treatment group significantly increasing in IBR. Participants did not display significant change from entry to exit on the ESCS variables (IJA and IBR).

Discussion

Targeted interventions focused on joint attention and requesting, joint engagement, and play skills can improve social communication abilities of children with autism (Kasari et al. 2006, 2008, 2010). For children with the most impairment, these interventions can also make change, with moderate to large effect sizes in a small sample.

This study tested whether a limited dose of intervention could effect change on core deficits of young children with autism—engagement, play diversity, and social communication. In this study, 24 sessions were distributed over 12 weeks. While this was a relatively brief and low density intervention, there were strong results for improving diversity of play on an experimental measure and some indication of decreasing time spent unengaged in their classroom settings. Both of these findings were in generalized settings, with different adults and environments than the intervention. Results were mixed, but also promising for improving generalized initiated requesting gestures. Although targeted, there was no improvement in generalized joint attention gestures.

Targeting play and engagement were two skills that were more directly, and immediately, related in this population. Developing a diversity of play skills may directly translate to increased engagement with toys and activities in free-play settings in their classroom. The specific focus, and finding, with play diversity is important. Rather than teaching children how to play with specific items or defined play scripts, we targeted developmentally appropriate play within a range of toys. It may be that this specific approach effectively facilitates generalization to other settings, i.e., the classroom. It is important to mention that classroom teachers and aides were not provided training or recommendations about the intervention provided to their students. Additionally, the toys used in intervention were not from the children's classrooms. These findings suggest that young, minimally verbal children with autism can be taught and benefit from targeting engagement in functional activities using a naturalistic developmental/behavioral teaching approach.

There are several limitations to the study, most importantly the small sample size. Over two and a half years, only 15 children with autism were identified as being non-responsive to intensive behavioral interventions in this particular school setting. Another limitation is that greater changes were in initiating requesting gestures, yet initiating joint attention gestures were also a specific focus of the intervention. One factor may be the developmental readiness for joint attention skills, and the real difficulty in improving initiating joint attention skills in this sample of children (Kasari et al. 2010). The short duration of the intervention may have also been a factor. Development of play and engagement may be

among the first areas to change, but spontaneous communication may require more intervention time and practice.

In summary, this pilot intervention study shows promise in improving play and engagement outcomes for children identified as 'nonverbal' and making limited progress despite receiving intensive behavioral interventions. Progress was made in a short period of time (12 weeks) with a low dose of intervention (12 h), and changes were observed in the child's performance in their classroom, and on independent assessments. Thus, future studies are warranted that continue this line of investigation.

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Fig. 1.
Study design and randomization procedure

Table 1

Descriptives, mean (SD), across time

	Control			Treatment		
	Baseline Month 0 <i>n</i> = 8	Entry Month 3 <i>n</i> = 8	Exit Month 6 <i>n</i> = 6	Baseline Month 0 <i>n</i> = 7	Entry Month 3 <i>n</i> = 7	Exit Month 6 <i>n</i> = 5
CA	54.68 (10.25)		60.55 (9.36)	48.73 (11.68)		58.84 (10.98)
MSEL						
MA	13.91 (3.85)			17.21 (3.91)		
DQ	26.67 (10.12)			37.70 (15.21)		
VR	21.50 (4.44)			22.42 (3.26)		
FM	19.13 (4.29)			21.71 (3.04)		
RL	8.63 (4.66)			13.86 (7.36)		
EL	6.38 (3.74)			10.86 (7.76)		
RDLS						
VC	12.00 (0.34)		12.05 (0.38)	12.14 (0.41)		14.59 (5.36)
EL	11.93 (0.09)		11.95 (0.16)	13.63 (4.57)		14.52 (5.38)
SPA						
Play Types	17.13 (6.83)	11.50 (5.10)	14.33 (9.69)	21.14 (7.58)	11.00 (8.74)	22.00 (10.17)
ESCS						
IJA	0.75 (2.12)	2.13 (2.80)	1.00 (1.73)	2.57 (4.39)	2.14 (4.85)	0.40 (0.89)
IBR	1.88 (1.55)	1.38 (0.92)	3.20 (2.39)	5.00 (3.70)	1.71 (1.38)	4.00 (1.87)
Class Obs.						
IJA		0.20 (0.45)	0.25 (0.50)		1.50 (3.21)	0.60 (1.34)
IBR		0.20 (0.45)	0.00 (0.00)		1.50 (1.76)	4.80 (4.49)
Unengaged (%)		57.40 (34.11)	35.00 (16.08)		44.50 (14.86)	12.60 (10.85)

All developmental variables are reported in months; *CA* chronological age; *MSEL* variables for the mullen scales of early learning; *RDLS* reynell developmental language scales; *SPA* structured play assessment; *ESCS* early social communication scales

Table 2

Group differences (Kruskal–Wallis test, H) by time point

	<u>Baseline</u>		<u>Entry</u>		<u>Exit</u>	
	<i>H</i>	<i>p</i>	<i>H</i>	<i>p</i>	<i>H</i>	<i>p</i>
Chronological age	1.62	0.20			0.27	0.60
MSEL						
Mental age	1.78	0.18				
Developmental quotient	1.93	0.17				
Visual reception	0.09	0.77				
Fine motor	1.11	0.29				
Receptive language	1.97	0.16				
Expressive language	1.35	0.25				
RDLS						
Verbal comprehension	1.24	0.27			0.81	0.37
Expressive language	0.05	0.82			0.81	0.37
SPA						
Play types	1.37	0.25	0.77	0.38	4.09	0.04
ESCS						
Initiating joint attention	2.52	0.11	0.43	0.51	0.41	0.52
Initiating requesting	1.24	0.27	0.37	0.55	0.74	0.39
Class obs.						
Initiating joint attention			0.34	0.56	0.00	1.00
Initiating requesting			1.61	0.21	6.61	0.01
Unengaged (%)			0.21	0.65	3.87	0.05

MSEL mullen scales of early learning; *RDLS* reynell developmental learning scales; *SPA* structured play assessment; *ESCS* early social communication scales

Table 3

Wilcoxon signed-ranks test for change on outcome variables from Baseline to Entry for whole group, and Entry to Exit by group

	<u>Control</u>		<u>Treatment</u>		<u>Whole group</u>	
	<i>z</i>	<i>p</i>	<i>z</i>	<i>p</i>	<i>z</i>	<i>p</i>
Baseline-entry						
<i>n</i>	8		7		15	
SPA						
Play types	-1.82	0.07	-1.99	0.05	-2.74	0.01
ESCS						
IJA	-1.29	0.20	-0.41	0.68	-0.72	0.47
IBR	-1.19	0.23	-1.36	0.18	-1.75	0.08
Entry-exit						
<i>n</i>	6		5			
SPA						
Play types	-0.11	0.92	-2.03	0.04		
ESCS						
IJA	-1.60	0.11	0.00	1.00		
IBR	-1.10	0.27	-1.36	0.18		
Class obs.						
IJA	0.00	1.00	-0.45	0.66		
IBR	0.00	1.00	-1.22	0.22		
Unengaged (%)	-0.82	0.41	-2.02	0.04		

The *z* value is presented for each of the Wilcoxon signed-ranks tests for change from Baseline to Entry, and Entry to Exit, along with the *p* value