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Language Outcome in Autism: Randomized Comparison of Joint Attention and Play Interventions

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This study reports results of a randomized controlled trial aimed at joint attention (JA) and symbolic play (SP) in preschool children with autism, with prediction to language outcome 12 months later. Participants were 58 children (46 boys) with autism between 3 and 4 years of age. Children were randomized to a JA intervention, an SP intervention, or control group. Interventions were conducted 30 min daily for 5–6 weeks. Assessments of JA skills, SP skills, mother–child interactions, and language development were collected at 4 time points: pre- and postintervention and 6 and 12 months postintervention by independent testers. Results indicate that expressive language gains were greater for both treatment groups compared with the control group, and results could not be explained by differences in other interventions in which children participated. For children beginning treatment with the lowest language levels, the JA intervention improved language outcome significantly more than did the SP or control interventions. These findings suggest clinically significant benefits of actively treating JA and SP skills in young children with autism.

Keywords: preschool children, symbolic play, joint attention, mother–child interaction, randomized clinical trial

Children with autism are seriously delayed in their development of language, and this delay is often what prompts families to seek a diagnosis. Yet language outcomes are also highly variable among these children. Some children develop age-appropriate language skills, while others remain nonverbal. By the age of 10–13 years, as many as one quarter to one half of children with autism still will not have developed language (Lord & Schopler, 1989; Sigman & Ruskin, 1999). Given the often-cited finding that children who speak by the time they are 5 or 6 years of age have the best outcome (Lord, 2000; Rutter, 1978), parents and professionals are understandably concerned about interventions that emphasize language development during the preschool years.

In explaining the variability in language outcome, several studies have shown that joint attention (JA) ability is associated with language development. Children with autism who actively share and follow the attention of others (via coordinated attention to toys and people, showing toys or pointing to events and objects) also exhibit more sophisticated language skills (Charman et al., 2003; Dawson et al., 2004; Loveland & Landry, 1986; Mundy, Sigman, Ungerer, & Sherman, 1986). More impressive are studies that show that JA ability also predicts language ability. Thus, in longitudinal studies of children with autism who were initially tested during the preschool years, greater ability to initiate and respond to JA predicts language skills 1 year (Mundy, Sigman, & Kasari, 1990), 5 years (Charman et al., 2005), and 8 years later (Sigman & Ruskin, 1999).

JA skills may affect language outcome because sharing a focus of attention with others allows the child to acquire the types of skills that are socially learned, such as language (Adamson, Bakeman, & Deckner, 2004; Mundy, 1995; Tomasello, 1995). When children follow a speaker's line of vision, the speaker often labels an object or event that is the focus of attention (Baldwin, 1991). This practice creates *a joint focus of attention* in which children are more likely to link the focus of attention to the words used to reference the focus. Perhaps then it is not merely the acquisition of JA skills—such as pointing and coordinated joint looks—but rather a process of joint engagement between people and objects that supports the development of language.

Indeed, in studies that examine the predictive relation between JA skills and language development, a number of different measures have shown predictive utility. In some studies the greatest predictor of language is responding to the point of the experimenter (Mundy et al., 1990; Sigman & Ruskin, 1999). In other studies it is the rate of communicative intents (requesting behaviors, imitations, and initiations of JA) (Charman et al., 2005) or the duration of the joint engagement between the adult and the child (Adamson et al., 2004). While these measures differ, they repre-

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sent a similar process in which the child must monitor or attend to the communication of another.

It follows that teaching children with autism to engage with others and share communicative intent will improve their language outcomes. A few studies now document that JA skills can be taught to children with autism. For example, Whalen and Schreibman (2003) found that when they directly taught children to respond and initiate JA actions, four out of five 4-year-old children with autism improved. In this multiple baseline design, the authors found that responding to JA was easier to improve than initiating skills of coordinated joint looking and protodeclarative pointing. Responding skills were also better maintained and generalized to the mother who was not the treatment provider.

The current study builds upon a previously reported study in which JA skills were directly taught to young children with autism (Kasari, Freeman, & Paparella, 2006). In this group design, children were randomized to one of three intervention conditions: one that directly taught JA skills, one that taught symbolic play (SP) skills, and a control condition in which neither JA nor SP skills were directly taught. Results from this short-term intervention found that JA initiations and responses were significantly improved in the JA group, and SP skills were significantly improved in the SP group. At the end of treatment, both experimental groups performed significantly better than the control group did on independent tests of JA and SP. Significant differences were also noted in the children's interactions with their mothers. Mothers were not the treatment providers in this study so that assessment of children with their mothers was used as a generalization test of the intervention.

What is less clear is whether changing JA skills has any effect on children's language trajectories. Few examples exist in which treatments are linked to specific developmental outcomes. In one, Drew et al. (2002) implemented a randomized controlled trial of parent training for JA with 24 young children with autism. Half of the children received parent training for encouraging JA, and half received available community services. Compared with community controls, more children in the parent-implemented JA training group improved from nonverbal status to single-word or phrase speech (7 vs. 2). However, the small sample size likely contributed to only marginally significant differences between groups in parent-reported language development after one year. These data suggest that focusing on JA may lead to significant improvements in language but larger samples, and measures other than parent report are needed in future studies.

In teaching JA skills to children with autism, then, an important question is whether changes in JA skills can facilitate children's language development. In the University of California at Los Angeles (UCLA) randomized controlled trial study mentioned above (Kasari et al., 2006), children's JA, SP, and language skills were reassessed at 6 and 12 months postintervention. We hypothesized that positive changes in JA would result in positive changes in language development in children with autism at 12 months postintervention. SP skills were not expected to significantly affect language growth, given previous cross-sectional studies showing little association between SP and language skills in children with autism (Mundy et al., 1986; Sigman & Ruskin, 1999).

A secondary goal of this study was to examine predictors of language growth with the recognition that not all children benefit equally from an intervention. We expected that, consistent with other studies, children with higher developmental skills to begin with would show the greatest language growth. An exploratory goal of the study was to determine whether a particular intervention was more beneficial in facilitating language growth in children who were essentially nonverbal. To best understand the precise level of initial language that would result in a benefit from the intervention, we categorized children into two theoretically meaningful language-level groups: those that were producing fewer than five single, spontaneous words (corresponding to less than 20 months' language age) and those producing five or more spontaneous words and word combinations (corresponding to more than 20 months' language age) preintervention.

Method

This study reports on the data collected during follow-up assessments (January 1998 to March 2003) of children who had previously participated in a randomized controlled (RC) experimental treatment study during the period January 1997 to March 2002 (Kasari et al., 2006; also see the flow chart in Figure 1). Brief descriptions of the subjects and original intervention are included, but for details please see Kasari et al. (2006). Focus is placed on methods of the follow-up assessments.

Participants

Active treatment participants. Original RC experimental treatment participants included 58 children between the ages of 3 and 4 years. They met the following inclusion criteria: a diagnosis of autism on the Autism Diagnostic Interview—Revised (ADI–R) and the Autism Diagnostic Observation Schedule (ADOS), no seizure disorder or additional medical diagnoses (e.g., genetic syndromes), 5 years of age or under, and accessible for follow-ups (e.g., no international families). The sample consisted of mostly boys ($n = 46$), who were primarily Caucasian ($n = 37$) and had highly educated mothers ($n = 43$ who had completed college; see Kasari et al., 2006, for greater detail).

For all participants, informed consent was obtained at the outset of the original RC experimental treatment in accordance with UCLA Institutional Review Board procedures and regulations.

Follow-up participants. Follow-up RC experimental treatment participants included 56 children at 6 months postintervention—20 JA group, 19 SP group, and 17 control (CO) group—and 53 children at 12 months postintervention (20 JA group, 17 SP group, and 16 CO group). Those in the follow-up study were all participants of the original intervention study.

Only 2 children (both from the SP group) were lost at 6 months follow-up. Both children had moved out of state. One of these children had remained nonverbal and at the floor of the Reynell Receptive and Expressive Language scores from pre- to postintervention. The other child had made significant progress (e.g., 9 months and 2 months change from pre- to postintervention in Reynell Receptive and Expressive scores, respectively). At 12 months follow-up, 3 additional children were lost (2 from the SP group and 1 from the CO group). In all three cases, the families declined participation. In two of the three cases, the children had made no progress in Reynell Expressive and Receptive Language scores from postintervention to 6 months, and in the third case the child had made progress from postintervention to 6 months follow-up.

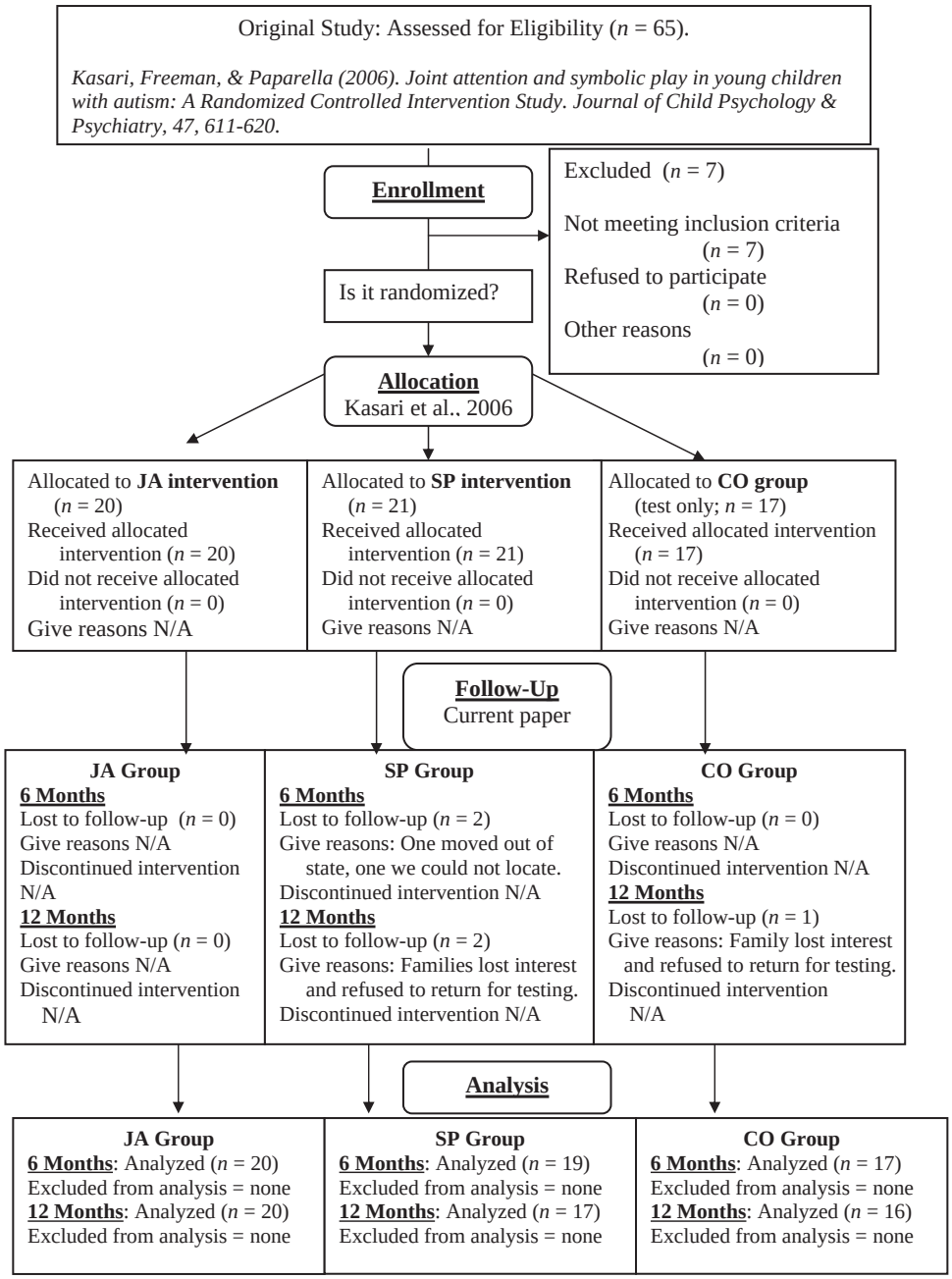

Figure 1. The CONSORT flow chart. JA = joint attention; SP = symbolic play; CO = control.

Developmental characteristics of the participants at preintervention and 6 and 12 months postintervention are presented in Table 1. Because some children scored at the floor of the Reynell Developmental Language Scales at Time 1(5 in the JA group, 7 in the SP group, and 7 in the CO group), we also include nonverbal mental age as scored from the Mullen Scales of Early Learning (Mullen, 1995).

Procedures

Active treatment. All of the children were attending the same applied behavior analysis (ABA)-based hospital day-treatment early intervention program (EIP) consisting of 30 hr of treatment per week, thus controlling for dose of intervention. The EIP was a special day-treatment program for children 2–6 years of age with autism, developmental disabilities, and/or behavioral disorders. It offered a multidisciplinary assessment and recommendations for interventions at home and at school. The program was structured with six 30-min periods of 1:1 or 1:2 ABA sessions, snack, lunch, three 30-min recess periods (indoors and outdoors), and dispersed self-help teaching sessions (e.g., toilet training, eating, and dressing/changing/grooming).

Table 1
Developmental Characteristics and Standard Deviations in Months

Child characteristic	Joint attention group				Symbolic play group				Control group			
	Pre	Post	6 mos. post	12 mos. post	Pre	Post	6 mos. post	12 mos. post	Pre	Post	6 mos. post	12 mos. post
Chronological age												
Months	43.20	44.68	51.40	58.25	42.67	44.60	51.53	57.59	41.94	43.47	50.24	56.63
SD	7.05	6.86	6.76	6.86	6.93	6.61	6.81	6.74	4.93	5.06	5.23	4.70
Mental age[a]												
Months	26.29	—	—	41.82	24.55	—	—	40.33	21.86	—	—	32.90
SD	8.71	—	—	12.09	8.09	—	—	13.24	9.26	—	—	14.54
Nonverbal composite age												
Months	28.65	—	—	47.37	27.60	—	—	42.82	24.34	—	—	35.87
SD	9.03	—	—	13.77	6.74	—	—	14.08	7.53	—	—	13.00
Developmental quotient												
Standard score	58.30	—	—	71.54	58.90	—	—	69.47	51.98	—	—	58.68
SD	17.18	—	—	20.68	18.21	—	—	22.32	21.84	—	—	26.31
Expressive Language[b]												
Score	20.60	23.15	27.35	35.70	21.43	23.67	31.26	38.29	19.41	21.18	24.18	28.06
SD	6.51	6.43	7.36	12.57	7.59	8.78	12.94	15.03	7.70	9.11	11.32	13.52
CI	17.55–23.65	20.14–26.16	23.90–30.80	29.82–41.59	17.97–24.89	19.67–27.66	25.03–37.50	30.57–46.02	15.45–23.37	16.49–25.86	18.36–29.99	20.86–35.27
Receptive Language[b]												
Score	20.55	22.80	27.00	31.85	21.00	24.12	29.05	35.06	17.53	18.76	24.00	27.31
SD	7.27	6.90	7.00	9.21	9.75	10.31	10.93	11.18	8.70	10.55	15.17	15.63
CI	17.15–23.95	19.57–26.03	23.73–30.27	27.54–36.16	16.56–25.44	19.43–28.81	23.78–34.32	29.31–40.81	13.06–22.00	13.34–24.19	16.20–31.80	18.99–35.64

Note. Dashes indicate data were not obtained. Pre = preintervention; Post = postintervention; CI = 95% confidence interval.
[a] From the Mullen Scales of Early Learning. [b] Reynell Language score.

Upon admission to the EIP, children were randomized to one of three experimental treatment conditions using a random list: a JA intervention, an SP intervention, or the control condition. Due to the admissions structure of the EIP, as well as institutional review board requirements at the time, children were randomized to a condition upon admission to EIP but prior to completing assessments for the study. After completing these assessments, 7 of the 65 children did not meet study eligibility criteria (e.g., did not meet ADI–R and ADOS criteria for autism, had an additional genetic syndrome or seizure disorder) and were therefore dropped from the study after randomization. The resulting group of randomized children included 20 children in the JA group, 21 children in the SP group, and 17 children in the CO group. A total of 5 children (4 from the SP group and 1 from the CO group) did not complete the follow-up assessments. All three groups received entry assessments, the JA and SP groups received their respective interventions 30 min a day, and all three groups received the exit assessments.

In terms of intervention procedures, children's goals in either JA or SP were determined from the assessment results and represented a developmentally appropriate skill that was not yet mastered. Trained experimenters (five graduate students in educational psychology experienced with children with autism) worked with each child daily for approximately 30 min. All students were trained in both interventions and randomly assigned to either treatment procedure. However the interventionist remained constant once assigned to a specific child.

The intervention incorporated both applied behavior analysis and a developmental approach. Each child first received approximately 5–8 min of discrete trial instruction to "prime" the targeted treatment goal. In the same session, the child worked on the target goal on the floor for 15–25 min in a child-driven session where the experimenter used developmental principles of milieu teaching (Koegel & Koegel, 1995; Warren & Kaiser, 1986). These included following the child's lead and interest in activities, talking about and expanding on what the child was doing, repeating back what the child said, giving corrective feedback, making eye contact, and making environmental adjustments to engage the child. Environmental manipulations were strategically used to facilitate the child's social and communicative attempts. It is to be noted, however, that even on the floor the targeted skill was still shaped using techniques such as systematic prompting and reinforcement.

Two different strategies were used in the milieu-based intervention on JA that were explicitly not used in the SP intervention. First, the experimenter imitated the child's actions on toys, and second, the experimenter facilitated play routines driven by the child's interests.

Targeted goals were considered mastered if the child demonstrated the goal in three different ways (types) at least three times and both at the table and on the floor. For example, if the goal was to learn to show objects to others, the child would need to show three different objects to the experimenter within the same session, and the action would need to be spontaneously initiated by the child and not prompted or suggested by the experimenter.

A treatment manual was developed for the RC experimental treatment, and detailed information on the treatment goals and teaching approach for both experimental treatment groups can be found in Kasari et al. (2006).

Assessments. Testers who were independent of the treatment staff and blind to child group assignment administered all assessments. Prior to beginning the RC experimental treatment, children were assessed with the ADOS (Lord, Rutter, DiLavore, & Risi, 1999) and parents were administered the ADI–R (Lord, Rutter, & Le Couteur, 1999) in order to validate the clinical diagnosis of autism. A battery of child assessments was completed, including the Mullen Scales of Early Learning, the Reynell Developmental Language Scales, the Early Social-Communication Scales (ESCS), and the Structured Play Assessment. The Mullen and Reynell are both standardized assessments commonly used with young children with autism. The ESCS and the Structured Play Assessment are experimental measures used with young children with autism. In addition, the mother and child were observed playing with each other with a standard set of toys for 15 min. Parents also completed a demographic questionnaire regarding background characteristics and their child's history of intervention. These assessments were repeated at the end of intervention (except for the Mullen and diagnostic measures), which co-occurred with the child leaving the EIP, approximately 5–6 weeks later.

Follow-up. Once the children from all three groups (JA, SP, and CO) left the EIP and our RC experimental treatment, they were followed with testing at 6 months and 12 months postintervention. At 6 and 12 months postintervention, the Reynell, ESCS, Structured Play, and mother–child interaction measures were repeated. At 12 months, the Mullen was readministered. Finally, parents were given the demographic questionnaire at each testing to report on the treatment their child received in the time since we last saw them, thus providing information on interventions received during the active treatment phase and the follow-up phases.

Early Social-Communication Scales. This procedure was repeated at all four time points (entry, exit, 6 months, and 12 months). The child and tester sit facing each other at a table with a set of toys in view but out of reach of the child (Seibert, Hogan, & Mundy, 1982). Toys include several small wind-up and hand-operated mechanical toys, a hat, comb, glasses, ball, car, balloon, and book. The child is presented with three trials of the mechanical toy, three trials of the hand-operated toys, and two trials of a social interaction game (i.e., singing a song with a tickle). The procedure is videotaped and later scored by coders who were independent of the intervention and assessment staff and blind to child group assignment. The coders overlapped coding on 20% of the sample, and reliability was estimated using two-way mixed effects model (consistency definition)—single rater intraclass correlation coefficient (ICC) value. These coefficients are reported after each variable below.

The major variables of interest for this study included frequency of both initiations and responses of JA behaviors. Initiations included coordinated looking (.77), distal pointing (.80), proximal pointing (.78), and showing (.79). Responses included responding to experimenter points (.81) and gaze (.83). The average ICC for initiations was .79, and for responses the average ICC was .82.

Structured Play Assessment. This test was repeated at all four time points (entry, exit, 6 months, and 12 months). The child is presented with sets of toys at a table (Ungerer & Sigman, 1981). Toys consist of three different-sized dolls, doll furniture, baby bottles, a tea set, a dump truck, a garage, blocks, a piece of paper, three pieces of sponge, a telephone, a brush, and a mirror. The entire play interaction lasts approximately 15–20 min. The child's play behaviors are videotaped and later coded.

Variables used in the analyses were (a) functional play types, (b) SP types, and (c) play level. *Functional play type* refers to the number of different novel, child-initiated functional play acts. An example would be a child who puts a spoon to his mouth several times as if to eat (Type 1) or puts a comb to his hair several times (Type 2). The number of times the child does each act is irrelevant, but the number of different types would be two. *SP type* refers to the number of different novel, child-initiated SP acts, from single scheme sequences to sociodramatic play. *Play level* represented the highest, most frequent, and flexible level at which the child played with mastery. Mastery was defined as the highest spontaneous play level attained with at least three different types/exemplars of that level. Play level ranged from 1 (*physical and conventional combinations*) to 14 (*sociodramatic and thematic/fantasy play*; Lifter, Sulzer-Azaroff, Anderson, & Cowdery, 1993; Ungerer & Sigman, 1981).

Reliability was calculated between two independent coders blind to group status and testing order for 12 subjects. Two-way mixed effects model (consistency definition)—single rater ICC value was .97 for functional play types, .99 for SP types, and 1.0 for play level.

Mother–child interaction. A 15-min videotaped interaction was collected for each child at all four time points (entry, exit, 6 months, and 12 months). Mothers were asked to play with their child as they normally would at home using a standard set of toys (including dolls, dishes, puzzles, truck, and blocks). The interaction was coded in two ways. First, we examined the child's play behaviors during the mother–child interaction and coded again for types of functional and SP acts (Lifter et al., 1993). A weighted score was used to create the mastered play level score to control for differences in opportunities that may have occurred between dyads. Each play act was multiplied by the level of play and then divided by the total number of acts. Two-way mixed effects model (consistency definition)—single rater ICC value was established between two independent coders blind to group status, and testing orders were .89 for functional play types, .99 for SP types, and 1.0 for play level.

Second, the mother–child interaction was coded for JA skills (ICC reported next to individual variables). The coding identified (a) amount of time (in seconds) in which parent and child were jointly engaged and interactive around objects (.65; Bakeman & Adamson, 1984); (b) who initiated joint engagement (parent or child, .95); and the child's frequency of JA skills (e.g., coordinated looks, .76; pointing, .77; and showing, .78). The overall ICC between two independent coders blind to group status was .78.

Demographic form. Parents were asked to complete a simple demographic form that asked for their child's birth date and ethnicity; the parents' age, occupation, and highest level of schooling completed; and the child's current and previous service and for how long the service had been received. Services included any interventions such as occupational, physical, and educational interventions (including various types of social skills training and tutoring). Measures of overall service hours and speech service hours were calculated. Because parents often wrote "approximately" or a range (e.g., 2–3 months) when responding to the question of how long their child had received particular services, we divided the year (between exit and 1-year follow-up) into four quarters (1–3 months, 4–6 months, 7–9 months, and 10–12 months). We then multiplied the hours per week of service that was reported by the families by the average weeks in each quarter (8 weeks, 20 weeks, 32 weeks, and 44 weeks, respectively). This yielded a single number for the hours of service the child had received over the past year and a single number specifically for the hours of speech therapy the child had received over the past year.

Analytic Strategy

The results are in three sections, and analyses include all participants at both 6 and 12 months assessments. First, we examine whether targeted interventions of JA or SP significantly affect children's language outcome 6 and 12 months later. Second, controlling for different treatments we examine child characteristics that may differentially predict language outcome. Finally, we examine stability and growth of skills that were directly targeted in intervention, JA and SP skill.

Whenever possible, composite measures of JA and SP skills were created to account for children's average performance across settings. Specifically, a composite variable for JA initiations was created by averaging the total frequency of initiations (i.e., pointing, showing, giving, and coordinated joint looks) across the mother–child interaction and ESCS contexts. A composite variable was also created to reflect the total number of novel child-initiated SP acts (i.e., SP types) that occurred across the mother–child interaction and Structured Play Assessment. Finally, averaging each child's highest level achieved within the mother–child interaction and Structured Play Assessment created a composite measure of children's highest level of play.

Results

Preliminary Analyses

We considered issues of nonnormality and missing data. The majority of our variables were counts, and we assumed a Poisson distribution rather than normality for such variables. For other variables, the indices of skewness and kurtosis were small and nonsignificant. Thus, no transformation of the data was required. In terms of missing data, only 5 subjects had missing data over the course of the entire study. We employed a method of analyzing growth over time (i.e., SAS Proc Mixed) that allows for missing data by conducting analyses on all available data points.

One-way analyses of variance (ANOVAs) were used to examine pretreatment differences in children's developmental levels. No significant differences in developmental levels were found between groups, including mental age ($p = .31$), developmental quotient ($p = .48$), expressive language ($p = .70$), receptive language ($p = .43$), and nonverbal mental age ($p = .23$). In Table 1 descriptive information is shown for all demographic and developmental data.

Growth in Language as a Function of Treatment

We examined the effect of intervention on growth in expressive and receptive language, conservatively controlling for mental age at onset. There was a significant difference among the groups in their rate of change in expressive language, $F(2, 164) = 6.84$, $p < .01$. Both the JA ($p < .01$; Cohen's $d = 0.59$) and SP ($p < .01$; Cohen's $d = 0.71$) groups showed significantly greater growth in expressive language over time than did the control group (see Figure 2). There was not, however, a significant effect of inter-

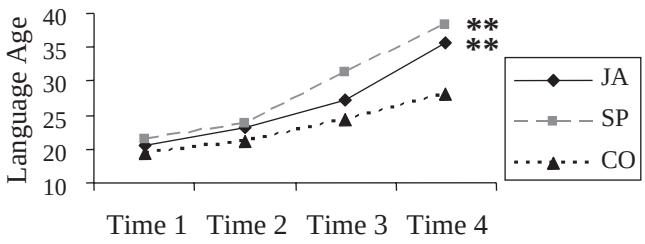

Figure 2. Growth in expressive language, measured in months. JA = joint attention; SP = symbolic play; CO = control group. **JA & SP > CO, $F(2, 164) = 6.84$, $p < .01$.

vention on growth in receptive language from preintervention to 12 months postintervention.

Predictors of Expressive Language Growth

Child variables. We next examined potential child and mother variables associated with expressive language outcome. Using an individual growth modeling approach, continuous response mixed-effect analyses were performed using SAS Proc Mixed software, version 8.01 (SAS Institute, 2000; Singer, 1998). We controlled for preintervention (i.e., Time 1) measures of mental age, expressive language, and the given predictor variable, the Group × Predictor effect, and for the effect of the intervention on growth in expressive language. In the case of significant Treatment × Expressive Language results, we followed up the results by testing individual comparisons using the SAS Estimate statement. Partial correlations, controlling for mental age, were conducted to assess the degree of association among predictor variables at the preintervention measurement. These analyses revealed a number of significant correlations (see Table 2). A number of measures of children's preintervention JA and SP skills were significant predictors of their growth in expressive language. To better control for the Type 1 error of multiple analyses, we used a Bonferroni adjustment to our p level for these individual analyses. Thus, all results listed below meet the overall criteria of at most $p < .05$ when adjusting for the total number of analyses (seven), and the corrected p levels for the individual analyses are reported. The average number of JA initiations significantly predicted growth in expressive language, $F(1, 109) = 38.95$, $p < .01$, as did responding to JA, $F(1, 109) = 15.65$, $p < .01$. Growth in expressive language was also positively predicted by the duration of child initiated JA episodes, $F(1, 109) = 9.30$, $p < .05$ (see Table 3).

With respect to the effect of children's initial SP skills, expressive language growth was significantly predicted by children's average highest level of play at Time 1, $F(1, 109) = 28.65$, $p < .01$, and by their total number of SP types, $F(1, 109) = 28.43$, $p < .01$. Finally, children's initial receptive language age preintervention significantly predicted growth in expressive language such that children with higher receptive language showed significantly more growth in expressive language, $F(1, 109) = 18.06$, $p < .01$ (see Table 4).

Low expressive language at onset. It was expected that children's initial level of expressive language would influence the effect of the interventions on language development. To test this hypothesis, we divided our sample into two expressive language categories: children whose expressive language age was less than 20 months on the Reynell at Time 1 and who produced fewer than five spontaneously initiated words, and those who produced more than five words with an expressive language age greater than or equal to 20 months prior to intervention. Growth curve analyses were conducted to test whether there was an interaction between expressive language category and language growth. The findings confirmed our hypothesis such that children with higher initial expressive language showed considerably greater growth in expressive language from preintervention to 12 months postintervention than did children who were initially lower in expressive language, $F(1, 165) = 33.41$, $p < .001$, Cohen's $d = 2.0$.

We next explored whether there was a significant difference among the intervention groups in terms of growth in expressive language for children who were initially low on expressive language ($n = 28$). Results revealed that there was a significant effect of intervention type for this subset of children, $F(2, 74) = 11.17$, $p < .001$. Children in the JA intervention showed significantly greater growth in expressive language than did those in both the SP intervention ($p < .01$; Cohen's $d = 0.63$) and the control group ($p < .001$; Cohen's $d = 1.22$; see Figure 3).

Longitudinal Effects of the Interventions

JA and SP skills. The next goal was to determine whether active treatment gains in JA and SP continued to grow over the follow-up period. Continuous response mixed-effect analyses were performed, and all count outcome measures were modeled using Poisson mixed-effect regressions and the GLIMMIX macro

Table 2
Partial Correlations Among Study Variables at Preintervention, Controlling for Mental Age

Variable	1	2	3	4	5	6	7	8
1. Receptive Language	—	.77***	.43***	.37**	.18	.23	.32*	.35**
2. Expressive Language		—	.33*	.39**	.30*	−.001	.31*	.32*
3. JA initiations composite			—	.24	.35**	.05	.34**	.40**
4. JA responses composite				—	.11	.12	.50***	.35**
5. Child-initiated JA duration					—	−.52***	.25	.23
6. Mother-initiated JA duration						—	.14	.10
7. SP level composite							—	.73***
8. SP types composite								—

Note. JA = joint attention; SP = symbolic play.
* $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Table 3
Means, Standard Deviations, and 95% Confidence Intervals (CI) of Joint Attention Measures at Four Time Points

	JA group				SP group	
Measure	Pre	Post	6 mos. post	12 mos. post	Pre	Post
JA initiations composite[b]						
M	3.95	5.23	5.44	6.44	4.32	4.70
SD	2.32	3.14	2.54	2.89	3.07	3.40
CI	2.86–5.04	3.76–6.69	4.25–6.63	5.09–7.79	2.92–5.71	3.16–6.25
JA responses[c,d]						
M	10.50	16.55	13.30	10.00	10.24	12.05
SD	5.42	6.64	7.48	3.58	5.59	5.91
CI	7.96–13.04	13.44–19.66	9.80–16.80	8.22–11.78	7.69–12.78	9.36–14.74
Child-initiated JA[d]						
M	140.00	299.15	244.90	363.55	128.14	212.48
SD	109.20	236.92	188.87	316.58	178.94	265.70
CI	88.89–191.11	188.27–410.03	156.51–333.29	215.39–511.71	46.69–209.60	91.53–333.42
Mother-initiated JA[d]						
M	449.05	420.10	469.35	348.40	432.43	520.95
SD	190.90	194.05	191.10	259.69	233.02	236.47
CI	359.71–538.39	329.28–510.92	379.91–558.79	226.86–469.94	326.36–538.50	413.31–628.59

Note. All variables are expressed in counts except for child- and mother-initiated JA, which are in seconds of duration. JA = joint attention; SP = symbolic play; CO = control; Pre = preintervention; Post = postintervention.
[a] Significant effects reflect differences between groups in growth over time in the specific measure. [b] Composite average from Early Social-Communication Scales and mother–child interaction. [c] From Early Social-Communication Scales ($p < .05$). [d] From mother–child interaction.

(Witte, Greenland, Kim, & Arab, 2000). All significant findings were followed up by testing individual comparisons using the SAS Estimate statement.

We examined the longitudinal effect of the interventions on JA initiations and responding skills by comparing the groups on their overall rate of change in these skills across time, controlling for children's mental age at the first time point. There was a significant difference among the intervention groups in their rate of change in JA initiation, $F(2, 164) = 5.35$, $p < .01$. Both the JA ($p < .01$; Cohen's $d = 1.02$) and SP ($p < .01$; Cohen's $d = 0.98$) intervention groups showed significantly more growth in initiations than did the control group across time (see Figure 4). In terms of responding skills, there was no significant difference between groups in the rate of change in these skills across the four time points.

Finally, there was a significant effect of intervention on growth in the duration of child-initiated joint engagement states, $F(2, 162) = 4.38$, $p < .05$. Children in both the JA ($p < .01$; Cohen's $d = 0.83$) and SP ($p < .05$; Cohen's $d = 0.62$) groups showed longer durations of child-initiated engagement over time than did the control group (see Figure 5).

We next examined whether there were differences among the intervention groups in terms of the rate of change in children's play skills over time, controlling for children's mental age at the first time point. Results revealed that there was a marginally significant difference in groups with respect to SP types, $F(2, 164) = 2.48$, $p = .087$, and that the SP group improved more than the control group did ($p < .05$; Cohen's $d = 0.72$; see Figure 6). It appeared that this result was mainly driven by children's play in the mother–child interaction, which showed considerable growth as a function of treatment, $F(2, 163) = 9.13$, $p < .001$. Specifically, within the mother–child interaction, the SP group showed more improvement across time than did both the JA ($p < .05$; Cohen's $d = 0.60$) and control ($p < .001$; Cohen's $d = 1.33$) groups. The JA group also improved significantly more ($p < .05$; Cohen's $d = 0.65$) than did the control group.

Finally, with respect to children's highest level of play, results revealed a significant group effect on growth, $F(2, 164) = 10.48$, $p < .001$, such that children in the SP group showed significantly more growth in play level than did those in both the JA ($p < .01$; Cohen's $d = 0.64$) and control ($p < .001$; Cohen's $d = 1.35$) groups (see Figure 7).

Intervention Services Following Experimental Treatments

Finally we assessed whether children differed in the number of hours of overall service and speech services they received during the one-year follow-up period. There were no differences in number of hours of overall service or speech service by child characteristics (i.e., language level, mental age, developmental quotient). Next, we assessed whether children in the three groups differed with respect to the total number of hours of overall services and speech services they received during the follow-up phase after treatment. Results of a one-way ANOVA revealed a significant group difference in overall services, $F(2, 46) = 5.37$, $p < .01$, such that children in the control group received a significantly greater number of total hours of services ($M = 1{,}548$ hours, $SD = 411$ hours) than did those in the JA group ($M = 1{,}289$ hours, $SD = 278$ hours; $p < .05$, Cohen's $d = 0.75$) and SP group ($M = 1{,}164$ hours, $SD = 285$ hours; $p < .01$, Cohen's $d = 1.10$, Student–Newman–Keuls post hoc test). There was not a significant difference between groups in terms of the number of hours of speech services they received ($p = .87$). The mean number of speech hours (and standard deviations) for the three groups were as follows: JA group ($M = 72$ hr, $SD = 34$ hr), SP group ($M = 70$ hr, $SD = 54$ hr), and control group ($M = 65$ hr, $SD = 31$ hr).

To determine whether hours of overall service or speech services affected growth in language, JA, or SP skills, we tested for

Table 3 (*continued*)

SP group		CO group				
6 mos. post	12 mos. post	Pre	Post	6 mos. post	12 mos. post	Significance[a]
						JA > CO, SP > CO
7.36	7.92	3.29	3.65	3.95	2.91	
4.43	4.81	2.74	2.89	3.03	4.12	
5.23–9.50	5.45–10.39	1.88–4.70	2.17–5.14	2.39–5.51	0.71–5.10	
11.94	10.88	10.52	9.35	8.29	9.30	
6.03	4.01	6.49	6.00	4.07	4.47	
8.84–15.04	8.82–12.95	7.19–13.87	6.27–12.44	6.20–10.39	6.10–12.50	
						JA > CO, SP > CO
190.58	309.00	229.53	128.47	197.06	129.40	
233.54	335.70	290.75	188.14	310.13	228.69	
78.02–303.14	136.40–481.60	80.04–379.02	31.74–225.20	31.80–362.32	2.76–256.05	
535.58	467.24	382.53	458.82	371.31	533.00	
222.76	277.21	225.62	207.12	228.66	242.12	
428.21–642.95	324.71–609.76	266.52–498.53	352.33–565.31	249.47–493.16	398.92–667.08	

Overall Service Hours × Time and Speech Service Hours × Time interactions in all study variables after controlling for children's initial mental age. With respect to overall service hours, the results revealed that the duration of mother-initiated JA episodes (in the mother–child interaction) was related to hours of overall services posttreatment such that the mothers of those children who had a greater number of hours of services postintervention showed an increase in the duration of mother-initiated JA interactions, whereas those mothers whose children had fewer hours of services showed a decrease in the duration of mother-initiated JA interactions, $F(1, 105) = 4.37$, $p < .05$, Cohen's $d = 0.21$. In addition, overall services were related to the duration of child-initiated JA episodes such that children with a lower number of hours of services showed greater growth in child-initiated JA episodes, $F(1, 105) = 4.25$, $p < .05$, Cohen's $d = 0.60$. There were no significant Speech Services × Time interactions in any of the study variables. Table 5 presents a summary of all study findings.

Discussion

The goal of this study was to determine whether improving JA in young children with autism would improve their language development. All children received a standard curriculum based on applied behavior analysis (ABA), with randomized groups of children receiving specific developmental and behavioral intervention in JA, or SP skills, or neither JA nor SP training. Both JA and SP are considered to be significantly deficient in young children with autism, and JA skills have been found to be predictive of later language outcome (Charman et al., 2003; Loveland & Landry, 1986; Mundy et al., 1990; Sigman & Ruskin, 1999). A secondary goal was to determine whether gains obtained during active treatment continued to improve over the postintervention phases of up to one year later. Finally, we wished to determine whom the interventions most benefited, with the hypothesis that children with the least amount of language would benefit the most from a JA intervention. Thus, we examined particular child characteristics that were likely to affect language outcome, as well as interactions of child characteristics and treatment condition.

A main finding of this study was that children who received a targeted JA intervention showed greater language growth over the course of 12 months than did children in the control group. We had theoretical and empirical reasons for believing that improving JA abilities would be associated with greater language growth in young children with autism. Although correlational studies have found significant associations between greater JA skills and higher-level language abilities (Mundy et al., 1990; Sigman & Ruskin, 1999), there has not been an experimental test of the hypothesis. Thus, these results provide confirmation of our prediction that improving JA would result in greater language growth. However, contrary to expectations, we found similar effects of the SP intervention on language growth. Children in both experimental groups had an average of 2.1 to 2.3 standard deviation gains in expressive language compared with an average of 1 standard deviation gain for children in the control group over the course of 12 months. Effect sizes were moderate to large (Cohen, 1988).

One reason both experimental interventions may have had similar effects on language was that the interventions required the child to co-construct an activity with the interventionist, thus establishing a joint focus of attention while working on specific skills (Adamson et al., 2004). Children were taught to initiate JA skills within the context of joint engagement with the experimenter, or taught to initiate SP skills while jointly engaged with the experimenter. Thus, this approach to joint engagement likely provided a foundation of expectations toward interaction that transferred to other individuals in the child's network (e.g., family members).

Compared with children in the control group, who received only the adult-directed, ABA activities characteristic of the early inter-

Table 4
Means, Standard Deviations, and 95% Confidence Intervals (CI) of Play Measures at Four Time Points

Measure	Joint attention group				Symbolic play group				Control group				Significance[a]
	Pre	Post	6 mos. post	12 mos. post	Pre	Post	6 mos. post	12 mos. post	Pre	Post	6 mos. post	12 mos. post	
Symbolic play level composite[b]													SP > JA, SP > CO
M	6.44	7.21	7.25	8.23	5.37	7.61	8.14	9.60	6.18	6.05	6.06	6.75	
SD	2.03	1.76	1.98	2.46	2.43	2.41	2.80	1.73	2.24	2.23	2.81	2.46	
CI	5.49–7.39	6.38–8.04	6.32–8.18	7.08–9.38	4.26–6.48	6.52–8.71	6.79–9.49	8.71–10.49	5.02–7.33	4.91–7.19	4.61–7.51	5.44–8.06	
Symbolic play types composite[c]													SP > CO
M	3.83	5.00	5.63	9.40	2.10	5.0	9.05	11.26	2.91	2.85	4.38	5.34	
SD	3.84	4.08	4.13	7.58	2.54	5.38	9.48	7.89	3.23	3.10	6.90	8.50	
CI	2.03–5.62	3.09–6.91	3.69–7.56	5.85–12.94	0.94–3.25	2.55–7.45	4.48–13.62	7.21–15.32	1.25–4.57	1.26–4.45	0.84–7.93	0.81–9.88	

[a] Significant effects reflect differences between intervention groups in growth over time in the specific measure ($p < .05$). [b] Composite average from structured play and mother–child interaction. [c] Possible values range from 1 to 14.

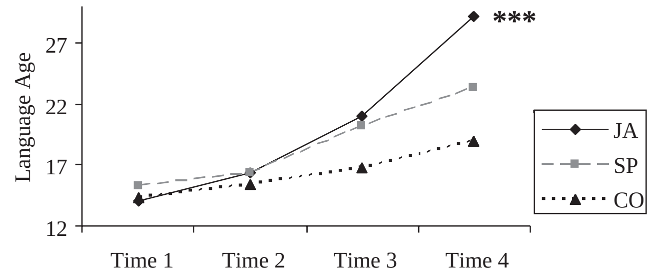

Figure 3. Growth in expressive language in months for children low in expressive language. JA = joint attention; SP = symbolic play; CO = control group. ***JA > SP & CO, $F(2, 74) = 11.17$, $p < .001$.

vention program that all children were attending, children in the complementary experimental interventions received a combination of developmental and behavioral teaching strategies that were child centered and adult supported. Although the current study cannot answer the question of whether a behavioral or developmental approach is more effective in facilitating language outcomes, findings do point to the potential importance of focusing on core deficits of developmentally selected JA and SP skills in young children with autism. These skills can be improved in a relatively brief period of time. However, there remain unanswered questions that should be addressed in future research. Since the experimental treatments were conducted for 30 min per day during a 6-hr day, it may be that they are effective only in combination with standard ABA interventions. We do not know whether the same effects would be found if children received usual or community care. We also do not know whether effects would be much stronger if children received an intervention that focused on JA and SP consistently throughout the day. Thus, issues about the intensity and density of the curricular focus need to be addressed in future studies.

Indeed, dose, method, and content are active ingredients of interventions that require careful examination (Kasari, 2002). In this study only content was clearly isolated, and our results suggest that focusing on joint engagement (whether in the context of learning JA skills or SP skills) with young children with autism results in better language outcomes than persisting solely with ABA activities. As noted above, method for the experimental treatments is confounded in that both developmental and behavioral approaches were used to teach children. However, dose was controlled in that all children received 30 hr of intervention per week. Moreover, treatment hours and type were monitored after

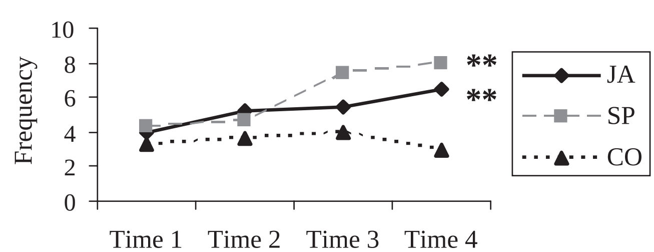

Figure 4. Growth in JA initiation skills in mother–child interaction and Early Social-Communication Scales. JA = joint attention; SP = symbolic play; CO = control group. **JA & SP > CO, $F(2, 164) = 5.35$, $p < .01$.

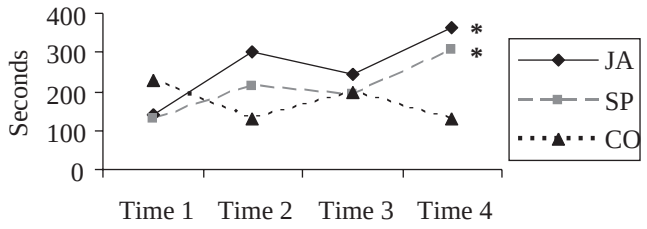

Figure 5. Growth in duration of child-initiated joint engagement in mother–child interaction. JA = joint attention; SP = symbolic play; CO = control group. *JA & SP > CO, $F(2, 162) = 4.38$, $p < .05$.

the end of active treatment, which also corresponded to children's departure from the day-treatment EIP. Most children continued to receive large numbers of treatment hours per week, but children in the control group engaged in more hours of intervention per week than did children in either the JA or SP group. The types of interventions varied, but all children engaged in speech hours per week as well as some type of educational program. An earlier study found that the number of speech hours per week significantly influenced language outcomes for young children with autism (Stone & Yoder, 2001). Thus, in this study we examined the number of speech hours specifically for its relationship to language outcome. We did not find a Treatment × Group interaction, nor was the number of speech hours significantly associated with language outcome.

What is difficult to determine from this study are the reasons why children received more or less hours per week and what effect various interventions (or the quality of these interventions) had on their development. For example, some children may have received more hours of intervention because parents were concerned about their progress. Whatever the reasons, children in this study received an optimal number of hours of treatment for young children with autism based on recommendations of the National Research Council (2001), thus highlighting the significance of our results.

A second important finding of this study is that the children receiving interventions on JA or SP continued to show growth and generalization in these skills after the experimental interventions ended and continued to significantly outperform the control group. Experimental treatments ended at the same time that children left the EIP day-treatment program and transitioned to community services, which typically did not target JA and SP skills. The previously noted specificity of the experimental treatments at the

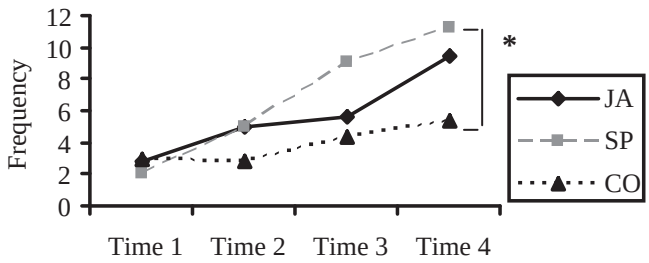

Figure 6. Growth in number of symbolic types in mother–child interaction and structured play. JA = joint attention; SP = symbolic play; CO = control group. *SP > CO, $F(2, 164) = 2.48$, $p = .087$.

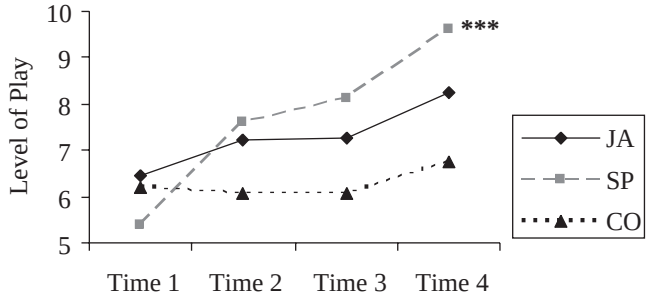

Figure 7. Growth in play level in mother–child interaction and structured play. JA = joint attention; SP = symbolic play; CO = control group. ***SP > JA & CO, $F(2, 164) = 10.48$, $p < .001$.

end of intervention (Kasari et al., 2006) was less the case at the 12-month follow up. In fact, comparing the treatments, children in the SP intervention demonstrated stronger effects in all areas at the 12-month follow up, including their growth of JA skills.

These findings suggest that while the two treatments yielded differences in JA and SP immediately following treatment, their later effects on language were more similar to each other than different. One interpretation of these results is that there is a

Table 5
Summary of Findings

Intervention-specific findings	Significant interventions
Growth in language as a function of intervention	
Significant growth occurred in expressive language for JA and SP interventions.	JA, SP
Growth in joint attention and play skills as a function of intervention	
Joint attention initiations improved for both JA and SP interventions.	JA, SP
Duration of child-initiated joint engagement states improved for JA and SP interventions.	JA, SP
Highest level of play and play types improved for SP intervention.	SP
Findings for children with low expressive language at onset	
Less growth occurred in expressive language overall.	
Greatest growth in expressive language occurred for children in the JA intervention.	JA
Significant preintervention predictors of expressive language growth	
Joint attention initiations	
Responding to joint attention	
Duration of child-initiated joint-attention episodes	
Symbolic play level	
Symbolic play types	
Findings concerning intervention services following experimental treatments	
Control group received greater number of total hours of services.	
Mothers of children with greater services had longer durations of mother-initiated joint-attention interactions.	
Children with fewer hours of services showed greater growth in child-initiated joint engagement.	

Note. JA = joint attention; SP = symbolic play.

collateral effect of the SP intervention on JA skills. In other words, as children learned to play symbolically with toys, their JA skills developed without direct teaching. Thorpe, Stahmer, and Schreibman (1995) found similar results in teaching 3 children play skills, and noted improvements in JA and affect even though these skills were not directly taught. Thus, SP skills may operate as a pivotal skill (Koegel, Koegel, & Carter, 1999) that allows for the development of other behaviors. Alternatively the common features of the two treatments (as discussed previously) may have better facilitated the development of JA skills than of SP skills. The fact that SP skills did not improve significantly for the JA group suggests that SP skills may require direct teaching, and are not as susceptible to collateral gains.

Another interesting effect of these treatments is that they seem to get stronger over time. Thus the differences between the control group and the two experimental groups are greater a year later than they are at the immediate end of treatment. Such findings have been noted in other studies (Yoder & Warren, 2002; Weiss, Harris, Catron, & Hans, 2003). For example, Weiss et al. (2003) found that an intervention on children with co-occurring internalizing and externalizing behavior problems did not show significant differences in parent reported internalizing problems at the end of treatment compared to a no-treatment control. There were significant treatment differences however at the follow up testing. Thus, the effects of treatment became more pronounced over time. As in our study it may be that repeated experiences (or attention to a particular developmental concern) over several months is necessary to demonstrate change in development.

Finally, we found that several pre-treatment variables significantly predicted language outcome. Not surprising, children who began treatment with higher developmental abilities progressed better in treatment. Children in this study who began with higher receptive and expressive language skills and higher mental ages responded better to treatment with significantly faster rates of language growth. Likewise children who already initiated more joint engagement with their mothers also had more rapid language growth. Thus, similar to other studies, children who are high functioning may progress faster regardless of treatment model (Ozonoff & Cathcart 1998). Because children were included in the study regardless of initial developmental ability, we have increased confidence in the generalizability of these findings to the general population of children with autism.

More difficult to find are appropriate treatment models for children who are lower functioning, or even non-responders to standard treatments. In this study, we found differences in treatment outcome by examining the lowest performing children, those with expressive language ages below 20 months (and producing fewer than 5 spontaneously initiated words). Children with this profile made greater language growth if they were randomized to the JA intervention than to the SP or control group. These individual differences in response to treatment are critically important to consider since about one half of children with autism fail to develop any meaningful language (Lord & Schopler, 1989; Wetherby & Prizant, 1992).

One reason why the JA treatment condition facilitated language development better for children who were developmentally young may be that the shared context of a joint engagement state allows a child to focus on a joint activity and on language without having to engage in reciprocal communication. This premise is consistent with typically developing data that more time in supported joint engagement between mothers and children facilitates language development presumably because by staying within the child's current focus the adult may reduce the demand for the child to shift attention, thus maximizing the child's ability to attend to new language (Adamson et al., 2004).

In summary, this study significantly improved JA and SP skills in young children with autism. Both experimental interventions had significant effects on the growth of later language skills. Generalizability of these findings is enhanced because children were included in the study regardless of initial developmental abilities thus reflecting the range in ability of children diagnosed with autism in the general population. Indeed, individual characteristics of children affected their response to the interventions. Findings suggest that interventions with young children with autism should focus on both JA and SP skills as they have significant effects on language acquisition.

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