Journal of Autism and Developmental Disorders, Vol. 36, No. 4, May 2006 (© 2006)
DOI 10.1007/s10803-006-0089-y
Published Online: March 28, 2006

Teaching Reciprocal Imitation Skills to Young Children with Autism Using a Naturalistic Behavioral Approach: Effects on Language, Pretend Play, and Joint Attention

Brooke Ingersoll,[1,2] and Laura Schreibman[1]

Children with autism exhibit significant deficits in imitation skills which impede the acquisition of more complex behaviors and socialization, and are thus an important focus of early intervention programs for children with autism. This study used a multiple-baseline design across five young children with autism to assess the benefit of a naturalistic behavioral technique for teaching object imitation. Participants increased their imitation skills and generalized these skills to novel environments. In addition, participants exhibited increases in other social-communicative behaviors, including language, pretend play, and joint attention. These results provide support for the effectiveness of a naturalistic behavioral intervention for teaching imitation and offer a new and potentially important treatment option for young children who exhibit deficits in social-communicative behaviors.

KEY WORDS: Autism; imitation; intervention; behavioral; social communication.

Autism is a development disorder characterized by pervasive deficits in social-communicative behaviors, including language, pretend play, and joint attention (APA, 2000). There is also a growing body of literature that demonstrates children with autism have deficits in imitation (see Rogers, 1999; Smith & Bryson, 1994 for reviews). In typical infants, imitation emerges early in development (Melzoff & Moore, 1977) and plays a critical role in the development of cognitive and social skills. Research suggests that imitation is associated with the development of language (e.g., Bates *et al.*, 1988), play (Fiese, 1990; Uzgiris, 1990), and joint attention skills (Carpenter, Nagell, & Tomasello, 1998). Given this association and the evidence for imitation deficits in autism, some researchers have suggested that imitation may be a primary deficit in autism that underlies the abnormal development of social-communicative behaviors (Meltzoff & Gopnik, 1994; Rogers, 1999; Rogers & Pennington, 1991; Smith & Bryson, 1994).

Research supports the association between imitation and social-communicative behaviors in autism. A longitudinal study of imitation and language in young children with autism found an association between imitation of body movements and the development of expressive language 6 months later (Stone, Ousley, & Littleford, 1997). In another study, Stone and Yoder (2001) examined the ability of a variety of child variables (play level, motor imitation, and joint attention) to predict language outcomes. They assessed 35 children with an autism spectrum diagnosis at age two and again at age four. After controlling for language skills at age two, they found only motor imitation ability and number of hours of speech/language therapy significantly predicted language outcome at age four, suggesting a strong

[1] University of California, San Diego, La Jolla, CA, USA.
[2] Correspondence should be addressed to: Brooke Ingersoll, Department of Psychology, Lewis and Clark College, 0615 SW Palatine Hill Rd, Portland, Oregon 97219, USA; E-mail: bri@lclark.edu

correlation between imitation and language development in children with autism. There is also a relationship between imitation and play skills in children with autism. For example, Stone *et al.* (1997) found that object imitation at age two was highly correlated with the development of play skills 1 year later, suggesting the importance of imitation in play development. Indeed, interventions targeting play in children with autism typically use imitation to teach novel play behaviors (e.g., Leaf & McEachin, 1999; Lovaas, Freitas, Nelson, & Whalen, 1967).

Research also suggests an association between imitation and joint attention in autism, although not as strong. Curcio (1978) found that gesture imitation was associated with the number of communicative gestures used by non-verbal children with autism. In another study, Carpenter, Pennington, and Rogers (2002) found that object imitation and coordinated joint attention were correlated with each other in preschool-aged children with autism. In this sample, object imitation preceded the development of joint attention, a pattern that was reversed for typically developing children (Carpenter *et al.*, 1998). The authors suggested that, unlike typical children, children with autism learn to use language through imitation rather than joint attention. Given these associations, researchers have suggested targeting imitation in young children with autism may promote the development of later social-communicative behaviors (Carpenter *et al.*, 2002; Klinger & Dawson, 1992; Rogers, 1999; Rogers & Bennetto, 2000; Tryon & Keane, 1986), highlighting the importance of interventions addressing imitation deficits early in autistic development.

Early intervention programs typically use a traditional behavioral approach, also referred to as discrete trial training, to target imitation skills (e.g., Leaf & McEachin, 1999; Maurice, Green, & Luce, 1996). In this approach, the learning environment is highly structured and controlled by the therapist, usually with the child and therapist facing each other in child-sized chairs. Imitative behavior is broken into a series of discrete sub-skills and presented in multiple, successive trials. Specific behaviors (e.g., clapping, placing a block in a box) are selected by the therapist from actions that the child is not yet performing spontaneously. Acquisition is facilitated by the use of explicit prompting, prompt fading, and contingent reinforcement (food or access to a preferred toy). Each action is taught individually in a block of 10 trials; however, several different actions may be targeted across blocks within a session. After mastery of an imitative action (e.g., 80% correct over three sets of 10 trials), random rotation of several mastered actions is presented within a single set of trials.

The traditional behavioral technique has documented success in teaching children to imitate a variety of non-verbal actions and words. Metz (1965) used physical prompting and food reinforcers paired with verbal praise to teach body and object imitation in two children with autism who had previously exhibited little to no imitative behavior. He found that after intensive training several imitative responses were maintained in the absence of reinforcement. Baer, Patterson, and Sherman (1967) replicated this experiment using a more controlled reversal design with children with mental retardation. They found that as training progressed, new imitations were increasingly easy to teach. In addition, the children imitated probe trials of imitations that had never been reinforced during training. The imitative behavior extinguished during the reversal, demonstrating the control of reinforcement over the behavior.

Lovaas and colleagues used a similar approach to teach verbal (Lovaas, Berberich, Perloff, & Schaeffer, 1966) and non-verbal (Lovaas *et al.*, 1967) imitation in response to a verbal discriminative stimulus (S^D) to children with autism. In both studies, imitation became increasingly easy to teach as it came under the control of the S^D. When reinforcement was delivered non-contingently, the behavior deteriorated. Laying the groundwork for current, comprehensive early intervention programs using a traditional behavioral approach, Lovaas *et al.* (1967) used the newly acquired imitative behavior to teach self-help and leisure skills.

Despite documented success at teaching imitation skills, several limitations of the traditional behavioral approach have been noted. First, training occurred in highly structured environments and used artificial reinforcers. Although generalization across actions was found, no studies examined generalization of these skills to non-treatment settings or therapists or the spontaneous use of imitation during play. Subsequent studies have shown that highly structured teaching environments and artificial reinforcers can impede generalization to the natural environment (Koegel, O'Dell, & Koegel, 1987; Lovaas, 1977; Spradlin & Siegel, 1982). Second, with the exception of one study (Metz, 1965), the imitative behavior was brought under the control of a specific verbal S^D (''Do this'' or ''Say''). Research has shown that when behavior is brought under tight stimulus control, its spontaneous use is compromised (Carr, 1981). Third,

maintenance of imitative behavior was dependent on continued reinforcement of some responses, suggesting that it did not acquire its own reinforcing properties. And fourth, imitative behavior was targeted as an isolated skill rather than in the context of other co-occurring social-communication behaviors and thus not representative of natural adult–child interactions (Schreibman, Kaneko, & Koegel, 1991). Thus this approach may actually hinder the spontaneous, social-communicative use of imitation in the natural environment (Koegel & Koegel, 1995).

Naturalistic behavioral treatments, such as incidental teaching, milieu teaching, and pivotal response training (PRT), have been designed to address the limitations of the traditional behavioral approach by incorporating behavioral techniques known to facilitate learning (i.e., multiple trials, explicit prompting and shaping, contingent reinforcement) with techniques known to facilitate early social-communicative behavior in typical children (i.e., contingent imitation, following the child's lead, linguistic mapping) (Warren, Yoder, Gazdag, & Kim, 1993). There is extensive literature to support the effectiveness of this approach for teaching language (see Kaiser, Yoder, & Keetz, 1992, for review), and more recently, prelinguistic communication (Warren *et al*., 1993), play skills (Stahmer, 1995; Thorp, Stahmer, & Schreibman, 1995), peer interaction (Pierce & Schreibman, 1995), and joint attention (Pierce & Schreibman, 1995; Whalen & Schreibman, 2003).

The naturalistic behavioral approach provides increased generalization (Charlop-Christy & Carpenter, 2000; Spradlin & Siegel, 1982) through naturally occurring teaching episodes and direct response–reinforcer relationships (Kaiser *et al*., 1992), increased spontaneity (Schwartz, Anderson, & Halle, 1989) by following the child's lead (Kaiser *et al*., 1992), and more natural adult–child interactions (Schreibman *et al*., 1991) because teaching is embedded in ongoing play interactions (Kaiser *et al*., 1992). Despite success addressing a variety of social-communicative behaviors, this type of intervention has not yet been used to teach imitation skills.

This study assesses whether immediate object imitation can be successfully taught using *reciprocal imitation training* (RIT), a naturalistic behavioral intervention, and whether increases in imitation lead to collateral changes in the children's language, pretend play, and joint attention behaviors.

METHOD

Participants

Five children with autism participated in this study. Children were diagnosed using DSM-IV criteria (APA, 2000) from an outside professional with expertise in autism and the first author using the Autism Diagnostic Observation Schedule-Generic (ADOS-G; Lord *et al*., 2000). The children ranged in age from 29 to 45 months at intake with mental ages ranging from 15 to 29 months on the *Bayley Scales of Infant Development, 2nd edition* (Bayley, 1993). The children's primary caregivers completed the *MacArthur Communication Development Index* (Fenson *et al*., 1993) to determine language age and the *Childhood Autism Rating Scale* (CARS; Schopler, Reichler, DeVellis, & Daly, 1980) to determine severity of autism. Language ages ranged from less than 8 months (non-verbal) to 25 months and level of autism severity ranged from mild-moderate to severe (see Table I).

All children exhibited deficits in spontaneous object imitation during play with others according to parent report and imitation of fewer than 10% of actions presented during an informal baseline session

Table I. Participant Characteristics at Intake

Child	Chronological age (mos.)	Mental age (Bayley) (mos.)	Language age (MacArthur CDI) (mos.)	Autism severity	
				(CARS)[a]	(ADOS)[b]
Connor	41	29	25	38.5	16[d]
Lena	45	23	22	33.5	14[c]
Heather	29	15	<8	42	16[c]
Nathan	34	16	<8	31.5	15[c]
Jason	34	16	17	31.5	13[c]

[a]Range of autism severity on the CARS: 15–29 = non-autistic, 30-36 = mildly-moderately autistic, 37-60 = severely autistic.
[b]Communication + Social Autism cut-off = 12.
[c]ADOS Module 1.
[d]ADOS Module 2.

with the experimenter. Three of the children had received discrete trial training in object imitation prior to participating in this study; however, no children received it during the study. In addition to difficulty with imitation, all of the children exhibited deficits in language, play, and joint attention as observed on the ADOS-G.

Setting and Materials

Sessions were conducted on the carpeted floor in two 8′ by 8′ treatment rooms. Generalization setting sessions were conducted in a 13′ by 14′ sitting room with two couches and a coffee table, or a 9′ by 12′ treatment room with a small table and chairs at an area preschool. All rooms had a one-way mirror through which assessments and treatment were filmed. Five sets of identical, developmentally appropriate toys were used in each session. Toys were chosen based on the child's interest and were varied each session so that over 50 different sets of toys were used with each child throughout the study. Generalization materials were novel toys not used during treatment.

Therapist Training

Therapy was conducted by the first author and undergraduate research assistants. Therapists ranged in age from 19 to 28. Each child worked with four to six therapists, who were predominately female; however each child worked with at least one male. Assistants were trained to 90% correct implementation of the intervention through didactic instruction, observation, and feedback provided during their first several sessions. Trained generalization therapists did not provide treatment to the participants.

Experimental Design and Procedure

A single-subject, multiple-baseline design was conducted across participants (Hersen & Barlow, 1976). Baselines were systematically staggered every 2 weeks. Baseline lengths were chosen a priori such that the shortest baseline (2 weeks) provided a sufficient number of data points to determine behavioral stability and that the longest baseline (10 weeks) was equal to the length of treatment. Participants came to the laboratory three days a week throughout the study. Twice a week, the children had three 20-minute sessions and once a week they had two 20-minute sessions, totaling eight, 20-minute sessions per week.

Baseline

Baseline sessions consisted of free play with a therapist. Every minute, on average, the therapist modeled an action with a toy paired with a verbal marker, totaling roughly 20 actions per session. Each action was modeled up to three times. Verbal markers were kept the same for each set of three models, but varied across trials (i.e., the therapist might model bouncing a ball while saying "up it goes," and model the same action at another time while saying "bounce, bounce"). Attempts were made to get the child's attention during modeling by facing the child and/or saying the child's name; however, no feedback was provided regarding the child's subsequent behavior. The therapist did not initiate additional interactions but complied with requests and briefly acknowledged comments made by the child.

The therapist modeled four types of actions: Familiar actions with the same toy the child was engaged with, novel actions with the same toy, familiar actions with a different toy than the one the child was engaged with, and novel actions with a different toy. Familiar actions were actions the child had performed independently on at least three occasions in a previous session and novel actions were those that child had not yet performed independently. Generalization sessions were conducted to determine generalization of the target behavior to a novel setting, novel play materials, and a novel therapist. During these sessions, all other components were kept the same except for the generalization target (setting, materials, or therapist).

Treatment

Treatment consisted of five phases that lasted for 2 weeks each. The phases were designed to work on the developmental progression of imitation in typical children, beginning with recognition of imitation (contingent imitation), followed by the imitation of familiar actions, and ending with the imitation of novel actions. Subsequent phases built upon previous phases by gradually incorporating more difficult tasks while interspersing maintenance tasks. In Phase I, no actions were modeled. In Phase II, only familiar actions were modeled with the same toy. In Phase III, familiar and novel actions were modeled with the same toy. In Phase IV, familiar and novel actions were modeled with the same toy and familiar actions were modeled with a different toy. In Phase V, familiar and novel actions were modeled with the same and different toys.

Treatment was composed of several naturalistic techniques. Contingent imitation, in which the therapist simultaneously imitated all of the child's actions with toys, gestures, and vocalizations, was used to gain the child's attention (Harris, Handleman, & Fong, 1987) and encourage responsivity to being imitated (Klinger & Dawson, 1992). Linguistic mapping, in which the therapist provided a running commentary of the actions that she and the child were simultaneously performing (e.g., Warren, 1993), was used to provide appropriate language models and to enhance the correspondence between the child and the therapist's actions. Beginning in Phase II, the therapist began interspersing contingent imitation of the child's behavior with bids for the child to imitate the therapist's behavior. The therapist followed the child's lead by modeling an action and a corresponding verbal marker up to three times with the duplicate of the toy the child was manipulating. As the phases progressed, actions were modeled with toys the child was not engaged with to encourage more flexible responding.

Actions were modeled every minute, on average, as during baseline, totaling roughly 20 actions per session. If the child imitated the action spontaneously, the therapist provided contingent reinforcement by praising the child and allowing continued access to the play materials. If the child did not imitate after the third model, the therapist physically prompted the child to complete the action and then provided praise.

Post-Treatment and Follow-Up

At the end of treatment and at a 1-month follow-up, each child participated in three to five, 10-minute post-treatment sessions and three generalization sessions (setting, therapist, materials) identical to baseline to assess whether behaviors maintained in the absence of contingencies, over time, and generalized to novel situations.

Fidelity of Implementation

To ensure correct implementation of the intervention, trained undergraduate research assistants scored fidelity of implementation from videotape on 10% of all sessions using 30-seconds interval scoring. The percent of intervals that the techniques were implemented correctly were: Modeled action (95.8%), contingent imitation (97.9%), linguistic mapping (100%), prompting (92.5%), and contingent reinforcement (93.2%).

Dependent Measures

Child outcome was determined by changes in performance during daily sessions. The first 10 minute of the first session of each day and all generalization sessions were videotaped and scored for imitation, language, pretend play, and coordinated joint attention. Imitation was scored as a percentage of the total number of actions modeled. Language and joint attention were scored using occurrence/non-occurrence data in 30-seconds intervals. Play behaviors were scored using frequency data (see Table II). Videotape scoring was completed by undergraduate research assistants trained to 80% accuracy on practice tapes.

In addition, several behavioral assessments were administered at pre-and post-treatment to determine skill acquisition and generalization. The *Motor Imitation Scale* (Stone *et al.*, 1997) is a structured imitation assessment that includes 8 object and 8 body imitation tasks. Both meaningful actions and non-meaningful actions are presented. Each action is modeled up to three times and then the child is instructed, "You do it." No further encouragement is provided. Participants receive 0 for no imitation, 1 for partial imitation, and 2 for complete imitation. Scores were converted to a percentage of the highest possible score (32).

The *Joint Attention Assessment* examines the child's ability to respond to the joint attention bids of an adult. This assessment is adapted from the procedure described by Loveland and Landry (1986). It includes placing the child's hand on an object, tapping an object, showing, pointing, and gaze shifting. Each bid is presented three times alone and paired with a verbal marker. Scores are a percentage of the total number of bids (30).

The *Structured Laboratory Observation* (SLO) is a non-standardized, observational assessment used to assess generalization to a novel setting, novel toys, and an untrained therapist (i.e., the child's caregiver) (Whalen & Schreibman, 2003). This assessment was conducted in the generalization setting and the toys presented were not available during any other assessments or treatment. The 15-minute observation is broken into three 5-minute segments in which the adult attempts to elicit different behaviors from the child within a naturalistic interaction. In the first segment, the adult elicits language, in the second, play, and in the third, imitation. The SLO was administered twice, once by a trained therapist and once by the child's caregiver. The therapist used

Table II. Behavioral Definitions for Session Data and the *Structured Laboratory Observation*

Total Object Imitation	Child imitates an action with an object within 10 seconds of the model. Imitation may not be exact, but must look distinctly like model. Child may use a different, but similar object. Must occur before another action is modeled by adult or child performs a different action
Combined Imitation	Child combines object imitation with verbal imitation of all or part of adult's verbal marker
Imitative Language	Child imitates all or part of adult's speech within 10 seconds of the adult's model. Includes imitation of verbal markers and linguistic mapping.
Spontaneous Language	Child uses speech that was not preceded by a verbal model, question, or gestural prompt. Must be in context and meaningful
Total Language	Child uses speech that was spontaneous or preceded by a verbal model, question, gestural prompt. Must be in context and meaningful
Total Pretend Play	Child performs a distinct action with miniature objects, directs a pretend action towards self, adult or inanimate object, uses object as if it were another object, attributes properties to an object which it does not have or refers to an absent object as if it were present
Spontaneous Pretend Play	Child performs a pretend play scheme that is not imitative (occurring within 30 seconds of a model). An imitated pretend scheme that continues more than 30 seconds after model or occurs later in the session is considered spontaneous
Appropriate Play	Child engages in play that is appropriate to toys and context of the interaction. Includes functional and pretend play
Coordinated Joint Attention	Child spontaneously coordinates gaze between object and adult for the purpose of sharing. Child must make eye contact with adult

Pivotal Response Training (PRT) to elicit target behaviors at least once every 30 seconds. PRT is a naturalistic behavioral intervention which enhances motivation by using natural reinforcement, child choice of tasks, turn-taking, reinforcement of attempted responses, and maintenance tasks (Koegel *et al.*, 1989). Caregivers were instructed to elicit behaviors any way they chose.

Interobserver Agreement

Interobserver reliability was obtained for 25% of observations. Kappa coefficients were calculated for each dependent measure yielding, .87 for total object imitation, .94 for combined imitation, .86 for imitative language, .83 for spontaneous language, .61 for total pretend play, .60 for spontaneous pretend play, and .73 for coordinated joint attention. Kappa coefficients for fidelity of implementation were .81 for modeled action, .66 for prompting, .86 for contingent reinforcement, .93 contingent imitation, and .93 for linguistic mapping.

Social Validity

Two groups of 32 college students in psychology were shown a 2-minute videotaped sample of each participant taken during the third and fourth minute of the language section of the SLO with the therapist at pre- and post-treatment (Schreibman, Koegel, Mills, & Burke, 1981). One group saw two of the children at pre-treatment and three of the children at post-treatment and the other group saw the same children at opposite points in treatment so that each rater only saw each child once. Consent was obtained from parents to allow individuals to rate their children's behavior. Raters were informed that they would be viewing five video clips of young children who were exhibiting some developmental difficulties and were kept blind to the children's point in treatment (pre or post). After viewing each segment, the participants completed a brief questionnaire about the child's imitation, language, play, and social behavior using a 7-point Likert-type rating scale designed for this study. The questionnaire contained the following questions: (1) To what extent does this child show an interest in the adult?; (2) To what extent does this child imitate the adult?; (3) To what extent does this child play with toys appropriately? (4) To what extent does this child use language appropriately? and (5) Compared to other preschoolers, how typical does this child look?. A score of *1* indicated that the child exhibited the behavior *not at all* and a score of *7* indicated that the child exhibited the behavior *very much*.

Data Analysis

Analysis of the session data was conducted using visual analysis (Gliner, Morgan, & Harmon, 2000). A resampling procedure was used to verify observed differences in treatment phases (Good, 2000).[1] In

cases where visual analysis and the resampling procedure conflicted (fewer than 5 of the 105 comparisons), the more conservative analysis was adopted, which was always the resampling procedure.

Changes in behavior across children from pre to post on the *Motor Imitation Scale*, the *Joint Attention Assessment*, and the SLO with the therapist and the caregiver were determined using one-way paired *t*-tests (see Table III). Unidirectional tests were chosen due to the small sample size and the predicted direction of effect. Due to the number of analyses, results should be interpreted cautiously. Analysis of the social validity data was conducted using a one-way ANOVA to determine differences in ratings for the autistic participants pre- and post-treatment (see Table IV).

RESULTS

Session Data

Total Object Imitation

All children showed low or moderate rates of total object imitation during baseline. Visual inspection indicates these rates remained stable throughout baseline, suggesting that maturation and exposure to the treatment setting, therapists, and materials did not affect rates of responding. With the onset of treatment, all participants exhibited significant increases in their rate of imitation. Rates maintained across treatment phases despite the introduction of more difficult tasks suggesting the children were learning the target skill in each phase. During the post-treatment sessions when the treatment was removed, four of the five children continued to exhibit rates similar to their treatment rates. In addition, they generalized their imitative behavior to novel materials, a setting, and a therapist. The fifth child, Nathan, exhibited a substantial decrease in his rate of responding once the treatment was removed, with his rate returning to near baseline levels during post-treatment (see Fig. 1).

At follow-up, all children, including Nathan, exhibited higher than baseline rates of total object imitation, suggesting the behavior was durable. The children also continued to exhibit generalized responding during the probes sessions; although four of the children failed to generalize to one of the three probes. This probe was different for each child, suggesting that no one novel situation was equally difficult across children.

Combined Imitation

During baseline, four of the five children exhibited no or only rare episodes of combined imitation and Connor exhibited variable rates. With the onset of treatment, the three verbal children, Connor, Lena, and Jason exhibited substantial increases in their use of combined imitations even though verbal imitation was never explicitly prompted. Heather also exhibited a small but significant increase despite being functionally non-verbal. Nathan did not change his use of combined imitations.

During post-treatment, the three verbal children continued to exhibit higher than baseline rates of combined imitation and generalized this behavior to the three novel situations. Heather did not maintain her treatment gains after the treatment was removed. Nathan exhibited a small, but non-significant increase above his baseline and treatment rate but did not exhibit any combined imitation during the generalization sessions, suggesting that combined imitations did not generalize to novel situations for the non-verbal children.

At follow-up, all of the verbal children continued to use combined imitation significantly more than during baseline. Connor and Lena generalized this behavior to all generalization sessions and Jason generalized his behavior to the generalization setting. Heather exhibited a return to her treatment level of combined imitations during her follow-up, suggesting that treatment gains maintained after a 1-month delay. Similar to his total object imitation performance, Nathan exhibited an increased rate of combined imitations during follow-up that was significantly greater than baseline. This rate was substantially higher than his treatment rates, suggesting that he continued to improve in his use of combined imitations after treatment was discontinued. Heather and Nathan did not use any combined imitations in the generalization sessions during follow-up.

Imitative Language

Low rates of imitative language were observed for all children at pre-treatment. Visual inspection indicates that these rates remained stable throughout baseline. Significant increases in imitative language were observed during treatment for all children. Visual inspection suggests that these changes were minimal during the first 2 weeks of treatment which consisted only of contingent imitation and linguistic mapping. However, during the second 2 weeks of treatment when imitation training was begun, all of

the children exhibited substantial increases in their use of imitative language (see Fig. 2).

At post-treatment, four of the five children maintained their gains. The three verbal children generalized their imitative language to all of the novel situations. Nathan exhibited generalization only to the novel setting and Heather did not exhibit any generalization, suggesting that like combined imitations, generalization to novel situations was more difficult for the non-verbal children, for whom

Table III. Performance on the *Structured Laboratory Observation*, *Motor Imitation Scale*, and *Joint Attention Assessment* at Pre- and Post-treatment

		Therapist		Caregiver	
		Pre	Post	Pre	Post
Structured Laboratory Observation					
Imitation (% of intervals)	Connor	3	13	3	13
	Lena	13	17	0	3
	Heather	13	20	13	23
	Nat0han	3	10	7	10
	Jason	7	33	–	20
	Mean (SD)	7.8 (5.0)	18.6 (8.9)[b]	5.8 (5.6)	13.8 (8.0)[b]
Language (% of intervals)	Connor	57	76	73	87
	Lena	60	50	20	40
	Heather	3	37	3	40
	Nathan	23	50	0	53
	Jason	60	73	–	87
	Mean (SD)	40.6 (26.2)	57.2 (7.5)[b]	24.0 (16.9)	61.4 (10.7)[b]
Total Appropriate Play Schemes (# of schemes)	Connor	14	29	16	26
	Lena	17	25	14	14
	Heather	8	15	10	15
	Nathan	17	23	16	20
	Jason	6	23	–	15
	Mean (SD)	12.4 (5.1)	23.0 (5.1)[a]	14.0 (2.8)	18.0 (5.1)
Coordinated Joint Attention (% of intervals)	Connor	57	40	53	40
	Lena	20	37	20	30
	Heather	30	7	23	17
	Nathan	13	39	10	39
	Jason	33	53	–	57
	Mean (SD)	30.6 (16.8)	35.2 (17.0)	26.5 (18.5)	31.5 (14.7)
Motor Imitation Scale					
Object Imitation Lena (% correct)	Connor	94	100		
	Lena	50	88		
	Heather	13	75		
	Nathan	25	75		
	Jason	0	100		
	Mean (SD)	36.4 (37.1)	87.6 (12.5)[b]		
Body Imitation (% correct)	Connor	94	100		
	Lena	81	94		
	Heather	94	88		
	Nathan	25	100		
	Jason	13	100		
	Mean (SD)	61.4 (39.3)	96.4 (5.37)		
Joint Attention Assessment					
(% correct)	Connor	73	90		
	Lena	70	93		
	Heather	60	63		
	Nathan	23	47		
	Jason	60	90		
	Mean (SD)	57.2 (20.0)	76.6 (20.5)[a]		

Note: Jason's pre-treatment SLO with his caregiver could not be conducted due to non-compliance.
[a] $p < .01$.
[b] $p < .05$.

Table IV. Means and Standard Deviations of Observer Ratings on the Social Validity Measure at Pre- and Post-treatment

	Pre *M(SD)*	Post *M(SD)*
To what extent does this child show an interest in the adult?	3.56 (1.40)	4.68 (1.65)[a]
To what extent does this child imitate the adult?	3.18 (1.48)	4.49 (1.69)[a]
To what extent does this child play with toys appropriately?	4.63 (1.69)	5.44 (1.43)[a]
To what extent does this child use language appropriately?	3.16 (1.67)	4.40 (1.75)[a]
Compared to other preschoolers, how typical does this child look?	4.25 (1.56)	5.41 (1.55)[a]

[a] $p < .001$.

language was far less established. At follow-up, four of the children's imitative language remained significantly greater than baseline. Jason's rate returned to baseline rates. Follow-up generalization sessions revealed that Lena, Connor, and Nathan continued to generalize their use of imitative language to some of the generalization probes, while Heather failed to exhibit any generalization. These findings suggest that the treatment retained its effect on imitative language for the majority of children after a 1-month delay, which generalized to some extent.

Spontaneous Language

Variable rates of spontaneous language were observed across children at pre-treatment. Visual inspection indicates that these rates remained stable throughout baseline for Connor, Heather, and Jason. Lena exhibited a gradually descending pattern of spontaneous language during baseline. Nathan exhibited slight increases in spontaneous language towards the end of his 8-week baseline, suggesting that he had small improvements before treatment was implemented.

The effect of the treatment on the use of spontaneous language varied across participants with two of the verbal children, Lena and Jason, making significant gains in their use of spontaneous language concurrent with the onset of treatment. In contrast, Connor, the most verbal child, actually showed a pattern of decreased use over the course of the intervention, but it was not significantly less than baseline. The two non-verbal children did not exhibit a significant change during treatment.

At post-treatment and follow-up, Lena and Jason continued to engage in spontaneous language at rates that were significantly greater than baseline which generalized to most novel situations. Nathan had a significant increase in spontaneous language during post-treatment and follow-up despite the fact that similar increases were not evident during treatment. Connor's spontaneous language at post-treatment was below his treatment and baseline rates, but returned to baseline rates at follow-up.

Total Pretend Play

Consistent with previous reports, pretend play comprised the minority of the children's play during baseline. Connor exhibited the highest number of pretend play schemes, Lena and Nathan exhibited a small number, while Heather and Jason rarely used any pretend play during baseline. Significant changes in four of the children's total pretend play occurred during treatment. Visual analysis suggests that these changes were not evident during the first 2 weeks of treatment; rather they became evident during Phase II when imitation training was begun. The three verbal children, Connor, Lena, and Jason used pretend play actions the most; however, Heather, the youngest and lowest-functioning child, also made significant gains, despite remaining functionally non-verbal (see Fig. 3).

Three of these children maintained their increased use at post-treatment and all four maintained it at follow-up. Although Nathan did not exhibit increases in his pretend play during treatment or post-treatment, he exhibited significantly higher than baseline rates at follow-up. Generalization probes during post-treatment and follow-up revealed that all of the children who exhibited increases in pretend play generalized this play to novel situations by follow-up.

Spontaneous Pretend Play

Pretend play represented an even smaller percent of the children's spontaneous play than their total play, which suggests that the modeling of play actions by the therapist during baseline promoted small increases in the children's use of pretend play. Significant changes in spontaneous pretend play during treatment were observed for Heather and Jason. Once again, visual inspection suggests that these changes were not evident until Phase II with the onset of imitation training. These increases maintained during post-treatment for Heather and for both children at follow-up and generalized to several novel situations.

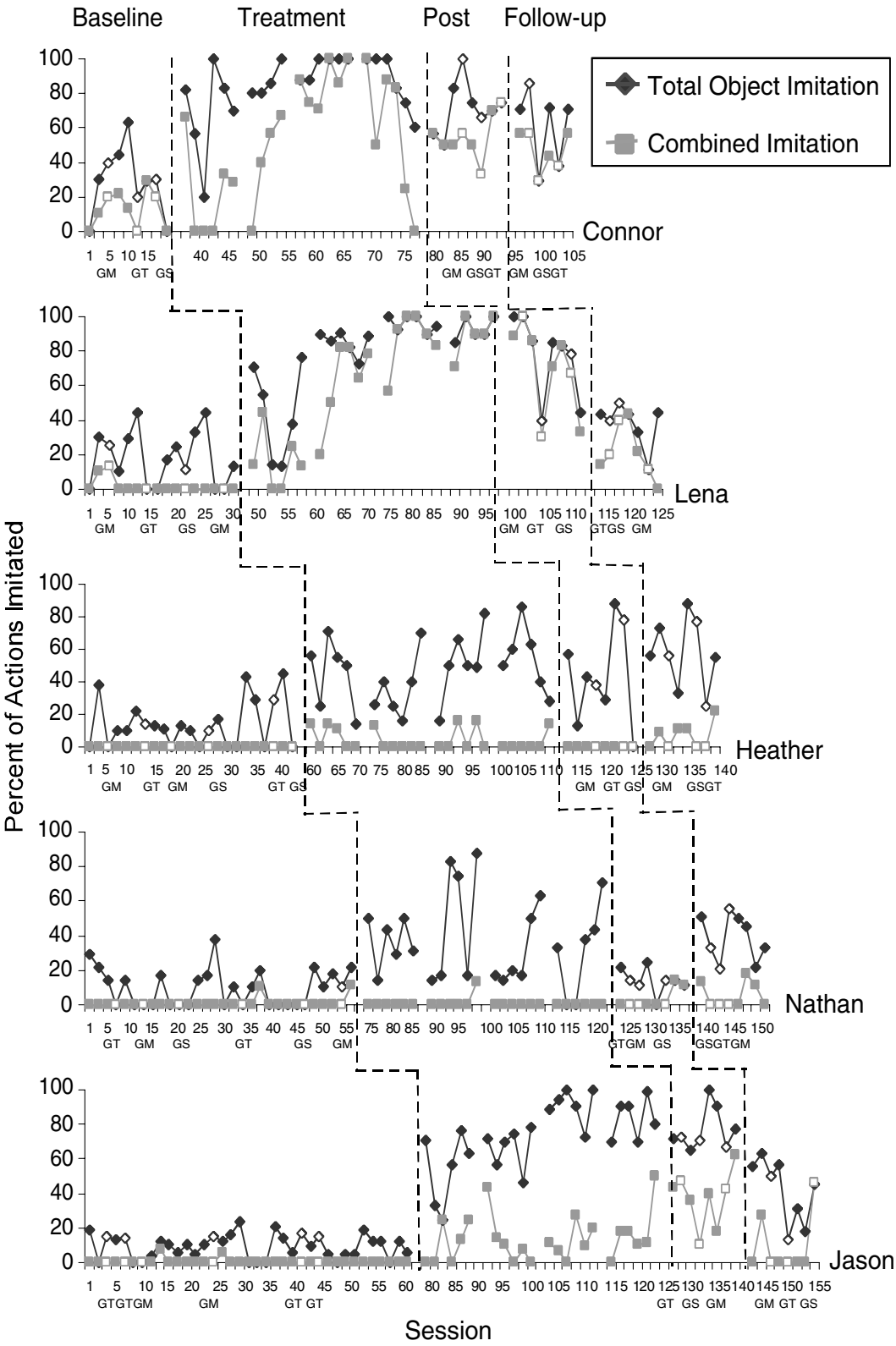

Fig. 1. Imitation during baseline, treatment, post-treatment, & follow-up. Closed data points represent the first session of each day, open data points represent generalization sessions: GM = generalization materials, GT = generalization therapist, GS = generalization setting.

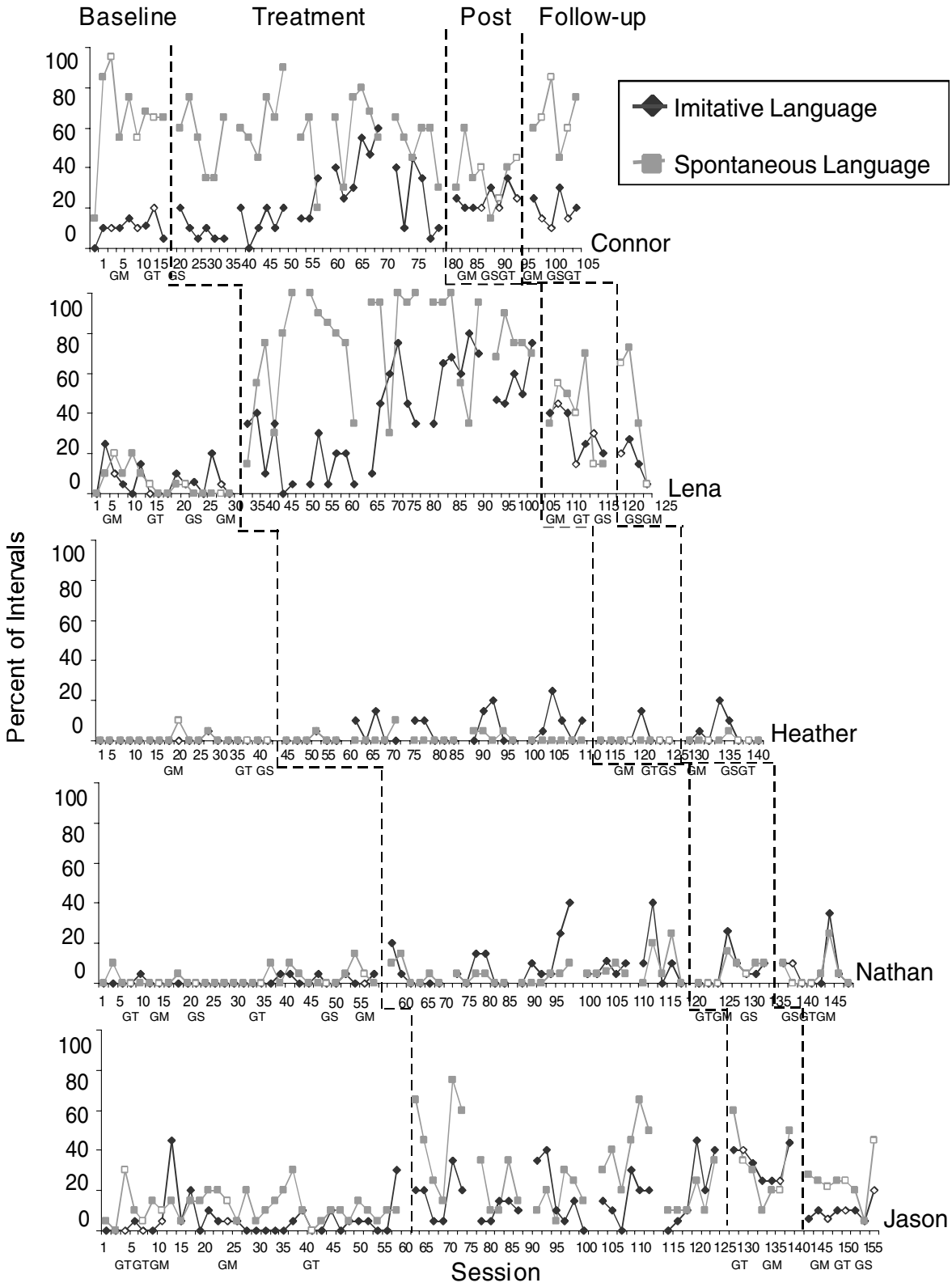

Fig. 2. Language during baseline, treatment, post-treatment, & follow-up. Closed data points represent the first session of each day, open data points represent generalization sessions: GM = generalization materials, GT = generalization therapist, GS = generalization setting.

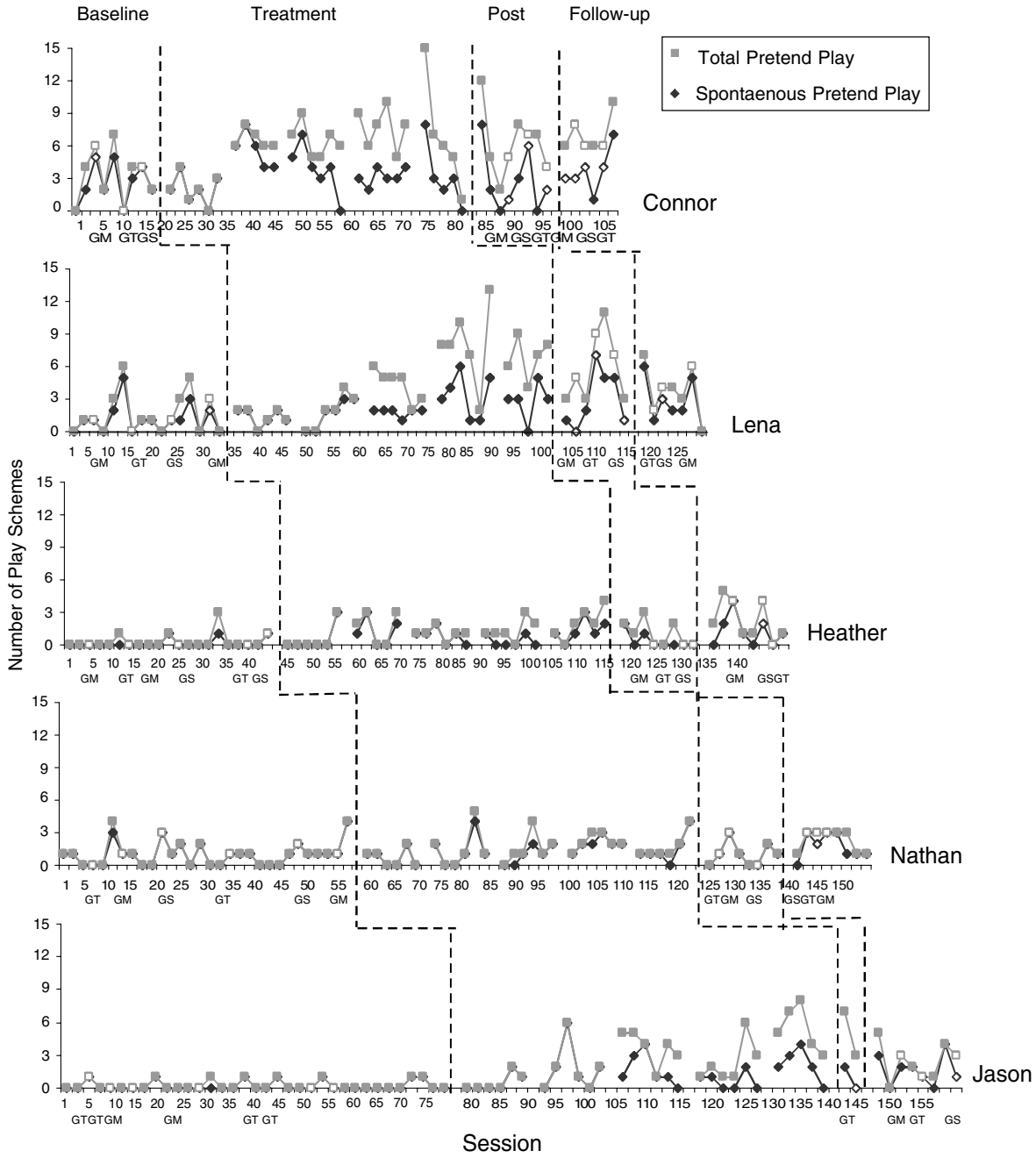

Fig. 3. Pretend play during baseline, treatment, post-treatment, & follow-up. Closed data points represent the first session of each day, open data points represent generalization sessions: GM = generalization materials, GT = generalization therapist, GS = generalization setting.

Coordinated Joint Attention

There was considerable variability across children in the use of coordinated joint attention (CJA) at baseline. Connor exhibited relatively high rates, averaging 38.9% of intervals. Lena, Nathan, and Heather exhibited low rates, and Jason exhibited intermediate rates of CJA (see Fig. 4). With the onset of treatment, all of the children exhibited an immediate increase in their use of CJA during the first several sessions. Throughout treatment, four of the

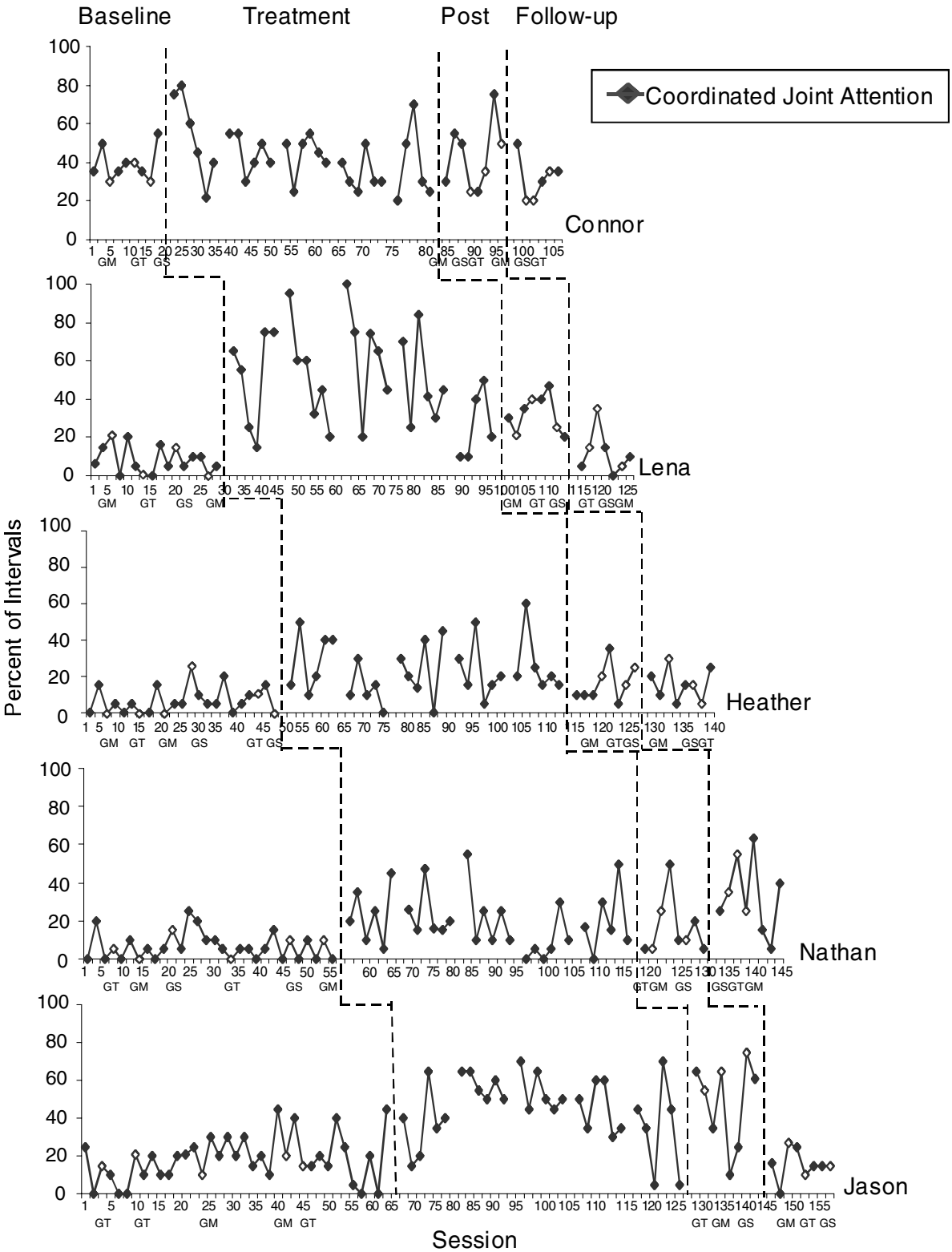

Fig. 4. Coordinated joint attention during baseline, treatment, post-treatment, & follow-up. Closed data points represent the first session of each day, open data points represent generalization sessions: GM = generalization materials, GT = generalization therapist, GS = generalization setting.

children continued to engage in significantly higher rates of CJA. Connor's rate returned to baseline after the initial treatment sessions and remained at baseline rates throughout treatment, post-treatment, and follow-up.

During post-treatment, Lena, Heather, and Jason continued to exhibit CJA at a significantly higher rate than baseline which generalized to all novel situations. Visual inspection suggests that Nathan's post-treatment use of CJA remained higher than baseline, but the resampling procedure indicates that this increase only approached significance. At follow-up, Lena's and Jason's CJA returned to baseline rates, suggesting that while their CJA maintained after the removal of treatment, it did not maintain over the course of a 1-month delay. In contrast, Heather and Nathan's use of CJA remained significantly higher than their baseline rates and generalized to all novel situations, indicating the durability of this behavior for these children.

Assessment Data

Motor Imitation Scale

At pre-treatment, the children's ability to imitate in a structured context varied considerably, with Connor exhibiting a near-perfect performance and Jason only performing one action correctly. At post-treatment, all participants exhibited an increase in their performance on the object imitation portion of the *Motor Imitation Scale*, which was statistically significant across children ($t(4) = 3.33$, $p < .05$). Four of the five children also exhibited an increase in their performance on the body imitation portion of the *Motor Imitation Scale*; however at the group level, this change was not significant ($t(4) = 1.83$, *n.s.*).

Joint Attention Assessment

All children exhibited increases in their ability to respond to joint attention bids of the adult. This increase was significant across children ($t(4) = 4.23$, $p < .01$).

Structured Laboratory Observation

All children exhibited an increase in their use of total object imitation, appropriate language, and appropriate play with the therapist from pre- to post-treatment on the SLO. These changes were confirmed with *t*-tests (imitation: $t(4) = 2.76$, $p < .05$; language: $t(4) = 2.20$, $p < .05$; play: $t(4) = 4.7$, $p < .01$). Due to non-compliance, Jason was unable to participate in the SLO with his caregiver at pre-treatment. The other children exhibited an increase in their use of total object imitation and appropriate language with their caregiver. These changes were confirmed with *t*-tests (imitation: $t(3) = 3.21$, $p < .05$; language: $t(3) = 3.52$, $p < .05$). Three of the four children had an increase in appropriate play from pre- to post-treatment with their caregiver, but this was not significant ($t(3) = 2.3$, *n.s.*). Inconsistent changes were observed in the use of coordinated joint attention from pre- to post-treatment with both the therapist and caregiver. Three of the children exhibited an increase in joint attention with the therapist and two with their caregiver, while the other two children exhibited a decrease with the therapist and their caregiver. Changes in joint attention behavior were not significant for the therapist ($t(4) = .45$, *n.s.*) or caregiver ($t(3) = .54$, *n.s.*).

Social Validity

Blind observers rated the children significantly better at post-treatment than pre-treatment. A one-way ANOVA confirmed significant differences in ratings for all behavioral categories (shows interest in adult: $F(1) = 43.35$, $p < .001$; imitates adult: $F(1) = 55.07$, $p < .001$; plays appropriately: $F(1) = 21.61$, $p < .001$; uses language appropriately: $F(1) = 42.63$, $p < .001$; appears typical: $F(1) = 44.89$, $p < .001$; see Table IV).

DISCUSSION

All children made substantial gains in their spontaneous object imitation. These gains maintained after the removal of treatment and over a 1-month delay and generalized to novel play materials, a setting, and a therapist. These findings suggest that RIT is effective for teaching generalized object imitation skills to young children with autism. The children also had increases in language, pretend play, and joint attention as a result of this intervention, suggesting that RIT leads to collateral changes in other social-communicative behaviors. Finally, naïve observers rated the children significantly better in their social-communication at post-treatment, indicating gains were evident to naïve observers during a 2-minute observation. Observers also found the children to look more typical at post-treatment, suggesting that the treatment led to global behavior change. These findings add further support to the behavioral measures and indicate the intervention is

socially valid. In all, the findings indicate that RIT is an effective early intervention strategy for young children with autism. A more detailed discussion of the intervention's effect on imitation, language, pretend play and joint attention is presented below.

Imitation

The strength of RIT is that it produced *generalized* imitation that maintained in the absence of reinforcement and over time. Significant increases were seen on generalization probes (therapist, setting, and materials) and the SLO. The SLO combines generalization materials, setting, and therapist (i.e., caregiver) as well as a different interaction style (the adult attempts to elicit behaviors in a more naturalistic interaction) and is thus a stringent measure of generalization. Object imitation also generalized to performance on a structured imitation assessment, suggesting that targeting imitation in a naturalistic setting can lead to increases in imitation in a structured setting. It is also possible that the children's imitation generalized across topographical boundaries (object, body, and verbal imitation). Four children increased their combined imitation and four children improved their imitation of body actions on the *Motor Imitation Scale* (although this change was not statistically significant across children). Additional studies are needed to determine whether RIT teaches truly generalized imitative responding.

This approach used multiple components so it is unknown which elements were necessary to promote imitation. It is possible that contingent imitation and linguistic mapping alone may have increased imitation. However, Nadel and Peze (1993) found that contingent imitation did not teach role-switching between being the imitate and the imitator. Thus it is likely that the physical prompting used in Phases II–V was necessary to produce the magnitude of change. Conversely, it is possible that contingent imitation and linguistic mapping did not effect imitation, although they were likely involved in the acquisition of other behaviors. Future studies examining the relative contribution of each intervention component to promote imitation in children with autism is needed.

Language

The findings suggest that RIT led to changes in the children's language. All of the children in this study exhibited gains in their imitative language and two of the children exhibited robust increases in their spontaneous language despite the fact that language was never specifically targeted. The children also exhibited significant increases in their use of appropriate language during the SLO with the therapist and the caregiver.

It is difficult to know which treatment components directly affected language use. Contingent verbal imitation (Gazdag & Warren, 2000) and linguistic mapping (Yoder, Kaiser, Goldstein, & Alpert, 1995) have both been shown to increase children's language use. Research has not documented that non-verbal imitation training increases language although verbal imitation training has been shown to increase speech production (e.g., Lovaas *et al*., 1977). It is likely that all three components (contingent verbal imitation, linguistic mapping, and non-verbal imitation training) contributed to the children's increase in verbal communication, although different components may have contributed to different forms of language.

This study was not designed to test which treatment components produced language change. However, given that this intervention used a phased approach, visual analysis of the children's language changes during treatment may provide a preliminary hypothesis regarding which elements contributed to different types of language gains. Although some of the children showed modest increases in verbal imitation with the onset of Phase I, none of the children demonstrated substantial increases in imitative speech until after the onset of imitation training (Phase II). This finding suggests that contingent imitation and linguistic mapping contributed to modest increases in imitative language while the non-verbal imitation training led to substantial increases in the children's verbal imitation. In contrast, the children whose spontaneous language increased showed these changes at the onset of Phase I, suggesting that contingent imitation and linguistic mapping were likely responsible for the increase in spontaneous speech. Future studies of the effect of the individual intervention strategies on children's language are needed.

Pretend Play

Findings from this study are consistent with the hypothesis that imitation is involved in the development of pretend play in young children with autism. Four of the five children exhibited an increase in their total use of pretend play. These changes were not evident during Phase I; rather they occurred after the onset of imitation training in Phase II. Changes were

also seen, although to a lesser extent, in two of the children's spontaneous pretend play. This finding suggests that the increases in pretend play were not simply due to increases in immediate imitation of pretend play actions, but may have involved deferred imitation as well as the generation of novel pretend play actions. It is unknown why Nathan did not exhibit increases in his use of pretend play despite his increased use of imitation. Future studies examining child characteristics that predict response in interventions targeting pretend play would be beneficial.

Joint Attention

Findings from this study suggest that RIT increases CJA and joint attention responding. Changes in CJA were observed with the onset of Phase I for four of the children. Given that previous research has suggested that contingent imitation increases the use of eye contact (Dawson & Galpert, 1990; Tiegerman & Primavera, 1984), positive affect (Harris *et al*., 1987), and CJA (Lewy & Dawson, 1992), it is likely that the contingent imitation in this study led to increases in CJA. The majority of the children maintained their increased use of CJA during post-treatment after the treatment had been removed. Previous research on the effects of contingent imitation found that its removal resulted in a return to baseline rates of eye gaze (Dawson & Galpert, 1990) and attention to the therapist (Harris *et al*., 1987) suggesting that behaviors were dependent on the therapeutic environment. It is possible that, with an extended post-treatment in the current study, the children's CJA would have extinguished. The fact that the two children who showed the greatest increases in CJA returned to baseline levels at the 1-month follow-up, lends support to this possibility. However, the fact that CJA maintained after the removal of contingent imitation may suggest contingent imitation was not exclusively responsible for the improvement in CJA. Typical children use spontaneous imitation during play as a social-communicative strategy to connect with a play partner (Eckerman & Stein, 1990). They also use more CJA during imitation than children with autism (Ingersoll, Schreibman, & Tran, 2003). Therefore, it is possible that the imitation targeted in this intervention supported the use of CJA once contingent imitation was removed.

The child who exhibited the highest rates of CJA during baseline did not increase his use of CJA. One explanation is that Connor was already exhibiting high rates of CJA during baseline and thus did not increase his use of CJA due to a ceiling effect. Another interpretation is that this intervention is more effective for increasing CJA in children with lower mental ages. Additional research on the effect of contingent imitation on CJA in children with varied pre-treatment levels of CJA is needed.

Weaknesses and Future Research

Although this study has some important implications in the treatment of young children with autism, several shortcomings are acknowledged. First, there was variability in the children's overall response to treatment, both in magnitude of behavior change and in the number of behaviors affected. Jason had the most favorable response to treatment with substantial increases in all seven behaviors measured while Nathan had the least favorable response with smaller changes in only three. Future studies examining child characteristics that predict treatment response would be beneficial. Second, RIT was not equally effective for increasing all social-communication skills. Across children, the most consistent increases were found in object imitation and imitative language, with changes evident in all of the children and relatively strong generalization and maintenance. It was moderately effective for increasing combined imitation, total pretend play, and coordinated joint attention, with changes seen in four out of five children. The least consistent responses were found in spontaneous language and spontaneous pretend play, with only two children showing changes in these behaviors.

In addition, although this study shows that RIT leads to changes in a variety of social-communicative behaviors, it does not provide conclusive evidence that *changes in imitation* produced these changes. For example, changes in spontaneous speech and coordinated joint attention occurred prior to the onset of imitation training, suggesting they were the result of contingent imitation and/or linguistic mapping, or that changes in one behavior (i.e., joint attention) affected the other (i.e., language). Either way, increases in these two behaviors were not likely a result of increased imitation skills. In contrast, changes in the use of imitative language and pretend play seem to be more directly related to increases in imitation as they occurred concurrently with changes in object imitation (Phase II). Future studies which directly test the hypothesis that teaching object imitation skills can affect imitative language and pretend play are needed.

Another unanswered question is whether targeting any social-communicative behavior using a naturalistic behavioral approach will lead to positive changes in other social-communicative behaviors. Whalen, Schreibman, & Ingersoll (in press) found that four young children with autism exhibited increases in language, social initiations, and imitation skills after being trained to engage in joint attention, supporting this possibility. However, other studies found that training language did not result in increases in CJA (Rocha, Sherer, Parades, & Schreibman, 1999) or symbolic play (Stahmer, 1995), suggesting that training early developing social-communicative behaviors may lead to changes in later emerging behaviors but not vice versa. Taken together, these findings offer some preliminary support for the theoretical foundation of a developmental approach to intervention. Additional research is needed to support this hypothesis.

Despite the inclusion of generalization probes and the caregiver-child SLO, behaviors were not assessed in the children's natural environment or during play with similar aged peers. In typical development, reciprocal imitation is a primary means of interaction between peers before language becomes firmly established (Eckerman & Didow, 1996); therefore, the use of reciprocal imitation with typical peers is perhaps more meaningful than its use with adults. Research on other naturalistic behavioral interventions suggests that it unlikely that imitative behaviors would have generalized to peers without direct intervention (e.g., Stahmer, 1995). Given the simplicity of the intervention technique, it is likely that typical peers could be trained to implement the procedure. A peer training program utilizing this technique might offer a more effective intervention for teaching reciprocal imitation, as it is with peers that typical children are most likely to engage in this behavior. Future studies addressing generalization to home and school settings as well as the long-term durability of treatment gains are needed.

Finally, the small number of subjects inherent in a single-subject design limits the generalizability of these findings across the range of autistic children. Additional large scale, group design studies which include children of different ages and functioning levels are needed to replicate the results and to determine expected patterns of outcome across a wider range of children with autism. In conclusion, this research offers a new and exciting treatment option that is simple and effective and can easily be incorporated into early intervention programs for young children with autism.

NOTE

1. A computer program randomly selected data points from the pooled data of the two comparison groups and placed them in two bins. The bin means were compared to determine if they were equal to or greater than the observed mean difference. This process was completed 1000 times for each comparison. Differences in performance were considered significant if the calculated mean difference was less than the observed mean difference on 95% or more of the simulations. Variations on this approach have been advocated for use in the analysis of multiple-baseline designs (Wampold & Warsham, 1986).

ACKNOWLEDGMENTS

This study was supported by a grant from the M.I.N.D. Institute Scholars Program and an APA Dissertation Research Award to the first author. We are grateful to the children and their families who participated in this research and the undergraduate research assistants who helped with this project. We also appreciate Mark Becker for his assistance with the statistical programming.

REFERENCES

American Psychiatric Association.. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: American Psychiatric Associationtext revision.

Baer, D. M., Peterson, R. F., & Sherman, J. A. (1967). The development of imitation by reinforcing behavioral similarity to a model. *Journal of the Experimental Analysis of Behavior*, *10*, 405–416.

Bates, E., Bretherton, I., Snyder, L., Beeghly, M., Shore, C., McNew, S., Carlson, V., Williamson, C., & Garrison, A. (1988). *From first words to grammar: Individual differences and dissociable mechanisms*. New York: Cambridge University Press.

Bayley, N. (1993). *Bayley scales of infant development* (2nd ed.). San Antonio, TX: Harcourt Brace & Company.

Carpenter, M., Nagell, K., & Tomasello, M. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development*, *63*, 176 .

Carpenter, M., Pennington, B. E., & Rogers, S. J. (2002). Interrelations among social-cognitive skills in young children with autism. *Journal of Autism & Developmental Disorders*, *32*, 91–106.

Carr, E.G. (1981). Sign language. In: O. I. Lovaas, A. Ackerman, D. Alexander, P. Firestone, M. Perkins, & A. L. Egel (Eds.), *The me book: Teaching manual for parents and teachers of developmentally disabled children*. (pp. 153--161). Baltimore: University Park Press.

Charlop-Christy, M. H., & Carpenter, M. (2000). Modified incidental teaching sessions: A procedure for parents to increase spontaneous speech in their children with autism. *Journal of Positive Behavior Interventions*, *2*, 98–112.

Curcio, F. (1978). Sensorimotor functioning and communication in mute autistic children. *Journal of Autism and Childhood Schizophrenia*, *8*, 281–292.

Dawson, G., & Galpert, L. (1990). Mothers' use of imitative play for the facilitation of social responsiveness and toy play in young autistic children. *Development and Psychopathology*, *2*, 151–162.

Eckerman, C., & Didow, S. (1996). Nonverbal imitation and toddlers' mastery of verbal means of achieving coordinated action. *Developmental Psychology*, *32*, 141–152.

Eckerman, C. O., & Stein, M. (1990). How imitation begets imitation and toddlers' generation of games. *Developmental Psychology*, *26*, 370–378.

Fenson, L., Dale, P., Reznick, S., Thal, D., Bates, E., Hartung, J., Pethick, S., & Reilly, J. (1993). *MacArthur communicative development inventory*. San Diego, CA: Singular Publishing Group Inc.

Fiese, B. (1990). Playful relationships: A contextual analysis of mother-toddler interaction and symbolic play. *Child Development*, *61*, 1648–1656.

Gazdag, G., & Warren, S. F. (2000). Effects of adult contingent imitation on development of young children's vocal imitation. *Journal of Early Intervention*, *23*, 24–35.

Gliner, J. A., Morgan, G. A., & Harmon, R. J. (2000). Single-subject designs. *Journal of the American Academy of Child & Adolescent Psychiatry*, *39*, 1327–1329.

Good, P. (2000). *Permutation tests: A practical guide to resampling methods for testing hypotheses* (2nd ed.). New York, NY: Springer-Verlag.

Harris, S. L., Handleman, J. S., & Fong, P. L. (1987). Imitation of self-stimulation: Impact on the autistic child's behavior and affect. *Child & Family Behavior Therapy*, *9*, 1–21.

Hersen, M., & Barlow, D. H. (1976). *Single case experimental designs: Strategies for studying behavior change*. New York: Pergamon.

Ingersoll, B., Schreibman, L., & Tran, Q. (2003). The effect of sensory feedback on immediate object imitation in children with autism. *Journal of Autism and Developmental Disorders*, *33*, 673–683.

Kaiser, A. P., Yoder, P. J., & Keetz, A. (1992). Evaluating mileu teaching. In: S.F. Warren, & J. Reichle (Eds.), *Causes and effects in communication and language intervention*. (pp. 9--48). Baltimore MD: Paul Brooks Publishing Co.

Klinger, L. G., & Dawson, G. (1992). Facilitating early social and communicative development in children with autism. In: S. F. Warren, & J. E. Reichle (Eds.), *Causes and effects in communication and language intervention*. (pp. 157--186). Baltimore, MD, US: Paul H. Brookes Publishing.

R. L. KoegelL. K. Koegel((1995). *Teaching children with autism: Strategies for initiating positive interactions and improving learning opportunities*. Baltimore: Paul H. Brooks Publishing Co.

Koegel, R. L., O'Dell, M. C., & Koegel, L. K. (1987). A natural language teaching paradigm for nonverbal autistic children. *Journal of Autism & Developmental Disorders*, *17*, 187–200.

Koegel, R. L., Schreibman, L., Good, A., Cerniglia, L., Murphy, C., & Koegel, L. (1989). *How to teach pivotal behaviors to children with autism: A training manual*. Santa Barbara: University of California.

Leaf, R., & McEachin, J. (1999). *A work in progress: Behavior management strategies and a curriculum for intensive behavioral treatment of autism*. New York: DRL Books.

Lewy, A. L., & Dawson, G. (1992). Social stimulation and joint attention in young autistic children. *Journal of Abnormal Child Psychology*, *20*, 555–566.

Lord, C., Risi, S., Lambrecht, L., Cook, E. H. Jr., Leventhal, B. L., DiLavore, P. C., Pickles, A., & Rutter, M. (2000). The autism diagnostic observation schedule-generic: A standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism & Developmental Disorders*, *30*, 205–223.

Lovaas, O. I. (1977). *The autistic child: Language development through behavior modification*. New York: Irvington.

Lovaas, O. I., Berberich, J. P., Perloff, B. F., & Schaeffer, B. (1966). Acquisition of imitative speech by schizophrenic children. *Science*, *151*, 705–707.

Lovaas, O. I., Freitas, K., Nelson, K, & Whalen, C. (1967). The establishment of imitation and its use for the development of complex behavior in schizophrenic children. *Behaviour Research and Therapy*, *5*, 171–182.

Loveland, K., & Landry, S. (1986). Joint attention and language in autism and developmental language delay. *Journal of Autism and Developmental Disorders*, *16*, 335–349.

C. MauriceG. GreenS. C. Luce((1996). *Behavioral intervention for young children with autism: A manual for parents and professionals*. Austin, TX, US: PRO-ED Inc.

Meltzoff, A. N., & Gopnik, A. (1994). The role of imitation in understanding persons and developing a theory of mind. In: S. Baron-Cohen, H. Tager-Flusberg, & D. Cohen (Eds.), *Understanding other minds; Perspectives from autism*. (pp. 335--366). Oxford: Oxford University Press.

Meltzoff, A. N., & Moore, M. K. (1977). Imitation of facial and manual gestures by human neonates. *Science*, *198*, 75–78.

Metz, J. R. (1965). Conditioning generalized imitation in autistic children. *Journal of Experimental Child Psychology*, *4*, 389–399.

Nadel, J., & Peze, A. (1993). What makes immediate imitation communicative in toddlers and autistic children. In: J. Nadel, & L. Camaioni (Eds.), *New perspectives in early communicative development*. (pp. 139--156). New York: Routledge.

Pierce, K., & Schreibman, L. (1995). Increasing complex social behaviors in children with autism: Effects of peer-implemented pivotal response training. *Journal of Applied Behavior Analysis*, *28*, 285–295.

Rocha, M., Sherer, M., Parades, S., & Schreibman L. (1999). The progression of joint attention behaviors in children with autism. Poster presented at the annual meeting of the Association for Behavior Analysis, Chicago, IL.

Rogers, S. (1999). An examination of the imitation deficit in autism. In: J. Nadel, & G. Butterworth (Eds.), *Imitation in infancy*. (pp. 254--279). Cambridge: Cambridge University Press.

Rogers, S., & Bennetto, L. (2000). Intersubjectivity in autism: The roles of imitation and executive function. In: A. Wetherby, & B. Prizant (Eds.), *Autism spectrum disorders: A transactional developmental perspective*. (pp. 79--107). Baltimore MD: Paul H. Brookes.

Rogers, S., & Pennington, B. (1991). A theoretical approach to the deficits in infantile autism. *Developmental Psychology*, *3*, 137–162.

Schopler, E., Reichler, R. J., DeVellis, R. F., & Daly, K. (1980). Toward objective classification of childhood autism: Childhood Autism Rating Scale, (CARS). *Journal of Autism & Developmental Disorders*, *10*, 91–103.

Schreibman, L., Kaneko, W. M., & Koegel, R. L. (1991). Positive affect of parents of autistic children: A comparison across two teaching techniques. *Behavior Therapy*, *22*, 479–490.

Schreibman, L., Koegel, R. L., Mills, J. I., & Burke, J. C. (1981). Social validation of behavior therapy with autistic children. *Behavior Therapy*, *12*, 610–624.

Schwartz, I. S., Anderson, S. R., & Halle, J. W. (1989). Training teachers to use naturalistic time delay: Effects on teacher behavior and on the language use of students. *Journal of the Association for Persons with Severe Handicaps*, *14*, 48–57.

Smith, I., & Bryson, S. (1994). Imitation and action in autism: A critical review. *Psychological Bulletin*, *116*, 259–273.

Spradlin, J. E., & Siegel, G. M. (1982). Language training in natural and clinical environments. *Journal of Speech and Hearing Disorders*, *47*, 2–6.

Stahmer, A. C. (1995). Teaching symbolic play skills to children with autism using pivotal response training. *Journal of Autism & Developmental Disorders*, *25*, 123–141.

Stone, W., Ousley, O., & Littleford, C. (1997). Motor imitation in young children with autism: What's the object?. *Journal of Abnormal Child Psychology*, *25*, 475–485.

Stone, W. L., & Yoder, P. J. (2001). Predicting spoken language level in children with autism spectrum disorders. *Autism*, *5*, 341–361.

Thorp, D. M., Stahmer, A. C., & Schreibman, L. (1995). Effects of sociodramatic play training on children with autism. *Journal of Autism & Developmental Disorders*, *25*, 265–282.

Tiegerman, E., & Primavera, L. (1984). Imitating the autistic child: Facilitating communicative gaze behavior. *Journal of Autism and Developmental Disorders*, *14*, 27–38.

Tryon, A. S., & Keane, S. P. (1986). Promoting imitative play through generalized observational learning in autistic-like children. *Journal of Abnormal Child Psychology*, *14*, 537–549.

Uzgiris, I. (1990). The social context of infant imitation. In: M. Lewis, & S. Feinman (Eds.), *Social influences and socialization in infancy*. (pp. 215--51). New York: Plenum Press.

Wampold, B. E., & Worsham, N. L. (1986). Randomization tests for multiple-baseline designs. *Behavioral Assessment*, *8*, 135–143.

Warren, S. F., Yoder, P. J., Gazdag, G. E., & Kim, K. (1993). Facilitating prelinguistic communication skills in young children with developmental delay. *Journal of Speech & Hearing Research*, *36*, 83–97.

Whalen, C., Schreibman, L., & Ingersoll, B. (in press). The collateral effects of joint attention training on social initiations, positive affect, imitation, and spontaneous speech for young children with autism. *Journal of Autism and Developmental Disorders*.

Whalen, C. M., & Schreibman, L. (2003). Joint attention training for children with autism using behavior modification procedures. *Journal of Child Psychology and Psychiatry*, *44*, 456–468.

Yoder, P. J., Kaiser, A. P., Goldstein, H., & Alpert, C. (1995). An exploratory comparison of milieu teaching and responsive interaction in classroom applications. *Journal of Early Intervention*, *19*, 218–242.

Young, J. M., Krantz, P. J., McClannahan, L. E., & Poulson, C. L. (1994). Generalized imitation and response-class formation in children with autism. *Journal of Applied Behavior Analysis*, *27*, 685–697.