Published in final edited form as:
J Autism Dev Disord. 2010 September ; 40(9): 1154–1160. doi:10.1007/s10803-010-0966-2.

Brief Report: Pilot Randomized Controlled Trial of Reciprocal Imitation Training for Teaching Elicited and Spontaneous Imitation to Children with Autism

Brooke Ingersoll, PhD
Department of Psychology, Michigan State University, East Lansing, MI, USA

Abstract

Children with autism exhibit significant deficits in imitation skills. Reciprocal Imitation Training (RIT), a naturalistic imitation intervention, was developed to teach young children with autism to imitate during play. This study used a randomized controlled trial to evaluate the efficacy of RIT on elicited and spontaneous imitation skills in 21 young children with autism. Results found that children in the treatment group made significantly more gains in elicited and spontaneous imitation, replicating previous single-subject design studies. Number of spontaneous play acts at pre-treatment was related to improvements in imitation during the intervention, suggesting that children with a greater play repertoire make greater gains during RIT.

Keywords

Autism; Imitation; Intervention; Reciprocal Imitation Training

Imitation is an important social-communication skill that emerges early in development (Meltzoff & Moore, 1977) and plays a critical role in the development of cognitive and social skills in young children (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Carpenter, Nagell, & Tomasello, 1998; Fiese, 1990; Uzgiris, M. Lewis, & S. Feinman, 1990). In children with autism, imitation has been found to be significantly impaired (Williams, Whiten, & Singh, 2004). In addition, deficits in imitation have been associated with impairments in other important social-communication skills, both concurrently (Sigman & Ungerer, 1984; Stone, Ousley, & Littleford, 1997) and over time (Stone & Yoder, 2001; Toth, Munson, N. Meltzoff, & Dawson, 2006). These findings have led a number of researchers to propose that imitation is a critical skill to target early in intervention, both in an attempt to improve a core feature of the disorder and as a method for improving other important skills (Ingersoll, 2008a; McDuffie et al., 2007; Rogers, Hepburn, Stackhouse, & Wehner, 2003)

Early attempts to teach imitation to children with autism relied on highly structured, adult-directed procedures and artificial reinforcement (Baer, Peterson, & Sherman, 1967; Lovaas, Freitas, Nelson, & Whalen, 1967; Metz, 1965). Although successful for teaching imitation in highly controlled environments, this approach has been criticized for its inability to produce generalized, spontaneous imitation that maintains in the absence of reinforcement (Dawson & Adams, 1984; Ingersoll, 2008a). Further, it is not representative of typical adult-child interactions in which early imitation skills emerge (Ingersoll, 2008a; Schreibman, Kaneko, & Koegel, 1991) and thus does not likely teach the social use of imitation (Ingersoll, 2008a).

Correspondence concerning this article should be addressed to Brooke Ingersoll, 105B Psychology Building, Michigan State University, East Lansing, MI 48824. ingers19@msu.edu.

This is a significant limitation given the growing evidence that children with autism have particular difficulty with the social function of imitation (Ingersoll, 2008b; Rogers et al., 2003). Despite these limitations, many early intervention programs continue to use this approach for lack of a better alternative.

The field is just beginning to embrace new methods for targeting imitation that are more likely to address the social use of imitation (Iacoboni & Mazziotta, 2007; Ingersoll, 2008a; McDuffie et al., 2007). Several such approaches have been described in the literature (Hwang & Hughes, 2000; Klinger & Dawson, 1992; Nadel, 2002), but limited research exists on their ability to teach spontaneous, generalized imitation in young children with autism. One approach, *Reciprocal Imitation Training* (RIT), is a naturalistic imitation intervention that emphasizes the social role of imitation (Ingersoll, 2008a). Previous research on RIT employing single-subject, multiple-baseline designs has shown this approach to be effective for teaching spontaneous object (Ingersoll & Gergans, 2007; Ingersoll & Schreibman, 2006) and gesture imitation (Ingersoll, Lewis, & Kroman, 2007) in young children with autism. Imitation skills generalized to untrained environments and maintained in the absence of reinforcement and over time. Importantly, changes in imitation were associated with improvements in other social-communication skills, including language, play, and joint attention (Ingersoll & Schreibman, 2006). Although these data are promising, the use of single-subject designs limits the generalizability of the findings. In order to further validate the efficacy of this approach for teaching imitation to young children with autism, it is necessary to apply the gold standard of a randomized controlled trial.

Thus, the goal of study was to conduct a pilot randomized controlled trial of RIT to examine its efficacy for teaching elicited and spontaneous imitation skills in young children with autism. A secondary goal was to identify child characteristics associated with gains during treatment.

Methods

Participants

Twenty-two children with autism between the ages of 27 and 47 months participated in this study. Participants were recruited from local agencies serving children with ASD (e.g., early intervention programs, diagnostic centers, parent support groups). One child who was assigned to the control group withdrew from the study after the pre-treatment assessments, yielding a total of 21 children included in the final data analysis. All children received a clinical diagnosis of autism based on DSM-IV-TR criteria from a licensed psychologist and met the cut-off for autism spectrum disorder on the Autism Diagnostic Observation Schedule-Generic (ADOS-G; (Lord et al., 2000). Table 1 presents participant characteristics by group.

Design and Procedure

Children were administered standardized assessments of cognitive, language, imitation, play, and joint attention skills at pre-treatment. Children were matched within three months on expressive language age and then randomly assigned to the treatment or control group. Children in the treatment group received 3 hours per week of RIT for 10 weeks and children in the control group received treatment as usual in the community. Children were reassessed on the imitation measures at post-treatment to determine the effect of treatment on elicited and spontaneous imitation skills.

Assessments

Primary Outcome Measures—The effect of the intervention on elicited and spontaneous imitation skills was examined using two imitation assessments. Both assessments were scored by trained research assistants blind to the participants' group assignment.

The *Motor Imitation Scale* (MIS; (Stone et al., 1997) was used to measure the children's ability to imitate in a structured, elicited context. It included 8 object and 8 gesture imitation tasks. Half of each type (object and gesture) was meaningful and half was non-meaningful. The examiner modeled actions at a table and provided explicit instruction for the child to imitate; however, she did not provide feedback based on the child's response. Responses were scored on a 3-point scale: a "2" was recorded if the child produced an exact imitation, a "1" was recorded if the child produced an emerging response (e.g., the child attempted to manipulate the toy in the correct manner, but failed to complete the act exactly as modeled), and a "0" was recorded if the child failed to imitate. For each action, only the best trial was recorded. Scores could range from 0 to 32. Cronbach's alpha for the MIS was .90, indicating good internal consistency. Reliability was calculated by two independent observers on 25% of participants. Cohen's Kappa collapsed across MIS items and participants was .93.

The *Unstructured Imitation Assessment* (UIA; adapted from (McDuffie et al., 2007) was used to measure the children's ability to imitate in a spontaneous, social-interactive context. It included 10 object and 10 gesture imitation tasks. All of the tasks were meaningful, although some of the object tasks involved manipulating the object in a non-standard way (e.g., banging two stacking cups together). The examiner engaged the child in free play with two sets of developmental appropriate toys and then alternated between imitating the child's nonverbal behavior (e.g., all object manipulation and body movements) and modeling actions for the child to imitate along with a verbal description of the action. The adult did not provide explicit instruction to imitate, prompt the child to imitate, or provide feedback on the child's response. The child's response was scored similarly to the MIS, with a "0" for no response or an incorrect response, "1" for an emerging response, and "2" for a full imitative response. Scores could range from 0–40. Cronbach's alpha for the UIA was .66, indicating moderate internal consistency. Reliability was calculated by two independent observers on 25% of participants. Cohen's Kappa collapsed across UIA items and participants was .84. See Table 2 for sample items from the MIS and UIA.

Pre-treatment Characteristics—Several standardized assessments were conducted to characterize the sample and identify potential predictors of differential treatment response. Cognitive level was measured using the cognitive scale of the *Bayley Scales of Infant Development, 3rd Edition* (BSID-III; (Bayley, 2005). Language skills were measured using the *Preschool Language Scales, 4th* Edition (Zimmerman, Steiner, & Pond, 2002). Responding to and initiating joint attention were measured using the *Early Social Communication Scales* (*ESCS*; Seibert, Hogan, & Mundy, 1982). Finally, play skills were measured using the *Structured Play Assessment* (SPA; (Kasari, Freeman, & Paparella, 2006; Ungerer & Sigman, 1981). Parents were asked to provide information on the amount and type of intervention services received outside of the study.

Group Assignment

Children were matched within three months on expressive language age on the PLS-4 and then one member was randomly assigned to the treatment group (n=11) and one member to the control group (n=10) using a coin flip. Expressive language age was chosen as the matching criterion based on previous research indicating a strong correlation between imitation and expressive language skills in typically developing children (Bates et al., 1979;

Snow, 1989) and children with autism (Dawson & Adams, 1984; Stone et al., 1997). This matching criterion has been used in a number of studies of imitation skills in young children with ASD, and is considered a more stringent matching criterion than nonverbal mental age (Smith & Bryson, 1994; Stone et al., 1997). The groups were compared on pre-treatment variables using independent samples t-tests for continuous variables and chi square for categorical variables. This matching procedure produced groups that were highly similar on most pre-treatment characteristics (ps>.05). The groups were not equivalent on elicited imitation performance at pre-treatment.

Treatment

Children in the treatment group received RIT targeting object and gesture imitation one hour per day, three days per week for 10 weeks. All treatments sessions were conducted in a small treatment room. Five pairs of identical play materials were used in all treatment sessions. Toys were varied each 20-minute session, totaling 15 sets of play materials per day. RIT uses several naturalistic techniques to teach imitation skills during play. To promote reciprocity, the therapist contingently imitated the child’s verbal and nonverbal behavior, described the child’s actions using simplified language, and expanded the child’s utterances. To teach imitation, the therapist modeled an action, either with an object or a gesture, once a minute on average. Actions were modeled up to three times, paired with a distinct verbal marker describing the action. If the child did not imitate the action within 10 seconds of the third model, the therapist physically prompted the child to complete the action. The therapist praised the child for imitation and returned to using contingent imitation and describing the child’s play. Language behavior, including verbal imitation, was not prompted or systematically reinforced.

The therapist taught object imitation by modeling an action with the duplicate of the toy the child was currently attending to. Modeled actions involved sensorimotor, functional, and symbolic play themes. The therapist taught gesture imitation by modeling a meaningful gesture related to the child’s play. Modeled gestures included those which convey conventional (e.g. “Where is it?” palms upturned) or affective (e.g., “Oh no” hands on face) themes and or describe objects (e.g., “Airplane” arms out), attributes (e.g., “Big” raise arms), and actions (e.g., “Spin” finger in circle). All modeled gestures involved the upper extremities to ensure that the therapist could physically prompt the correct response when necessary.

The goal of RIT is for the child to be able to imitate the majority of actions of a play partner rather than to be able to accurately produce specific actions in response to a model (Ingersoll & Schreibman, 2006). Therefore, rather than teaching the imitation of specific actions to criterion, multiple actions were targeted concurrently based on the context of the child’s play. Modeled actions were varied across toys to avoid associating a specific action with a specific toy. Further, although the verbal marker was kept consistent across the three presentations of the action within the trial, it was varied across trials so that it did not become associated with a specific toy or action. Finally, good attempts at imitation were also reinforced, even if the exact model was not reproduced.

All children received training in object imitation and nine also received gesture imitation training; gestures were not targeted for two children due to their low developmental age (<15 months). For children receiving both, object and gestures imitation sessions were alternated. See Ingersoll (2008a) for a more detailed description of the intervention.

Fidelity of Implementation—All therapy was conducted by research assistants trained to 90% correct implementation. Fidelity of implementation was scored on 10% of the sessions

NIH-PA Author Manuscript

NIH-PA Author Manuscript

using a rating scale developed for this study. Fidelity of implementation was high across sessions (mean=4.7 out of 5; range=3.3–5.0).

Results

Primary Data Analysis

Pre- and post-treatment scores on the two imitation measures were examined for skewness and kurtosis and were found to be positively skewed. Thus, the square root of the raw scores was taken to correct for skewness. The children's post-test performances on the elicited and spontaneous imitation measures were compared for the two groups using separate one-way ANCOVAs with post-test scores as the dependent variable and pre-test scores as the covariate. This procedure controls for initial group differences on relevant variables (Twisk & Proper, 2004).

After controlling for initial imitation performance, children in the treatment group made significantly more gains in elicited imitation than children in the control group, $F(1,18)=4.47$, $p<.05$, $\eta_p^2= .20$. Children in the treatment group also made significantly more gains in spontaneous imitation than the control group, $F(1,18)=7.49$, $p<.02$, $\eta_p^2= .29$, (see Figure 1).

In order to determine whether RIT was efficacious for increasing both object and gesture imitation, we examined changes in object and gesture imitation separately. To do this, we combined the object and gesture subscales for each measure into an overall object imitation and gesture imitation score. After controlling for initial imitation performance, children in the treatment group made significantly more gains in object imitation, $F(1,18)=4.88$, $p<.05$, $\eta_p^2= .21$, and gesture imitation, $F(1,18)=10.79$, $p<.01$, $\eta_p^2= .38$, than the control group (see Figure 2).

Exploratory Data Analysis

We conducted an exploratory analysis to examine whether any pre-treatment child characteristics were predictive of gains in different types of imitation skills during RIT. Pre-treatment scores were subtracted from post-treatment scores, yielding a change score for each type of imitation. Change scores for the treatment group were then examined in relationship to a number of pre-treatment child variables using bivariate correlations. Previous research has suggested a positive relationship between developmental skills and growth during treatment (e.g., Bono, Daley, & Sigman, 2004; Sallows & Graupner, 2005). Given the prediction of a positive association between developmental skills and skill acquisition, one-tailed tests were used.

Table 3 presents correlations between pre-treatment child characteristics and change scores for the treatment group. Changes in elicited and spontaneous imitation as well as object and gesture imitation performance were all significantly or marginally significantly associated with number of spontaneous play actions on the Structured Play Assessment (SPA) at pre-treatment. No other correlations approached significance (all ps>.10).

Discussion

This study examined the efficacy of RIT for teaching imitation skills to young children with autism using a randomized controlled trial. Children in the treatment group made greater gains in their spontaneous imitation skills on the UIA than the control group, replicating previous single-subject research (Ingersoll et al., 2007; Ingersoll & Schreibman, 2006). The UIA was designed to capture changes in the spontaneous, social use of imitation, which was the target of the intervention. Thus, the greater gains in imitation performance on the UIA in the treatment group are indicative of the ability of RIT to teach spontaneous, generalized imitation during play with a responsive partner. Previous work suggests that children with autism are significantly more impaired in their ability to imitate in spontaneous, social contexts than structured-elicited contexts (Ingersoll, 2008b). Thus, this finding is particularly noteworthy.

Further, the children in the treatment group also made greater gains in their elicited imitation skills on the MIS than the control group. This finding replicates our previous work which demonstrated an improvement on the MIS after participation in 10 weeks of RIT targeting object (Ingersoll & Schreibman, 2006) and gesture imitation (Ingersoll et al., 2007). These findings provide a stronger measure of generalization and suggest that teaching imitation skills using a naturalistic approach can lead to improvement in *both* spontaneous and elicited imitation skills.

In the current study, 9 of the 11 children in the treatment group received training in both object and gesture imitation. The children in the treatment group made greater gains on object and gesture imitation than the control group, suggesting that RIT is efficacious for teaching both types of imitation.

We attempted to ensure group similarity by matching for expressive language age at intake (Rogers et al., 2003; Stone et al., 1997). However, our groups were not comparable on elicited imitation at pre-treatment, with the treatment group exhibiting significantly better imitation on the MIS than the control group. Although we controlled for this discrepancy by using an ANCOVA, it is possible that the treatment group had a greater developmental readiness or general strength for developing imitation than the control group. Thus, replication is needed with groups of children that are equivalent on initial imitation performance in addition to expressive language age. It is likely that true randomization would not produce such groups; thus it would be important to stratify participants based on imitation scores and expressive language age prior to random assignment.

For children in the treatment group, the number of spontaneous play actions at pre-treatment was associated with amount of improvement in imitation skills. This finding suggests that an initial interest in objects or a greater play repertoire may be predictive of skill acquisition during RIT. This finding is not surprising given that the focus of RIT is to teach imitation using play materials. Children who engage in a greater number of spontaneous play acts may be more motivated by objects, and thus may find imitation more intrinsically motivating. It is also possible that children who interact with objects more have better motor skills and thus finding imitation easier. Alternatively, it may be that the children with a greater number of play schemas in their repertoire due to cognitive or developmental maturity may simply have more familiar schemes to draw upon, increasing their likelihood of imitation during intervention. Our finding is also consistent with previous research on pivotal response training, a naturalistic language intervention, which found that amount of toy manipulation was a predictor of treatment response (Sherer & Schreibman, 2005). Thus, amount of spontaneous play may be a predictor of response to naturalistic/play-based interventions more generally. Given our small sample size, we were unable to examine a moderated treatment effect, which would indicate whether a greater number of spontaneous play acts was differentially predictive of treatment response rather than growth in general (Yoder & Compton, 2004). More research with a larger sample of children is necessary to determine whether spontaneous play is a meaningful predictor of differential treatment response to RIT.

These findings add to treatment research indicating that low-intensity, focused interventions can significantly improve autism-specific deficits in targeted social-communication skills

(Kasari et al., 2006). This study examined short-term gains in imitation skills. Additional research is needed to examine the long-term effects of RIT on imitation in a larger sample of children. Further, it is important to examine the long-term effects of teaching imitation skills on language and social development (Rogers et al., 2003). Previous research has shown that a short-term, focused intervention targeting either joint attention or symbolic play can lead to greater language gains one year later (Kasari, Paparella, Freeman, & Jahromi, 2008). Given the relationship between imitation and long-term gains in language in children with autism (Stone & Yoder, 2001; Toth et al., 2006), as well as our previous single-subject research indicating collateral gains in verbal imitation and coordinated joint attention as a result of RIT (Ingersoll & Schreibman, 2006), the possibility that RIT may have long-term effects on language and social skills should be explored.

Finally, all of our participants were under the age of four at the beginning of treatment. Thus, additional work with older children is needed to determine whether the intervention is appropriate for children of a range of ages who exhibit significant deficits in imitation skills.

Acknowledgments

Brooke Ingersoll was funded by an Autism Speaks Treatment Award (#5020). I would like to thank the families who participated in the research. I appreciate Naomi Hatt and Nicole Bonter and the many undergraduate research assistants for their assistance with data collection.

References

Baer DM, Peterson RF, Sherman JA. The development of imitation by reinforcing behavioral similarity to a model. Journal Experimental Analysis of Behavior. 1967; 10:405–416.

Bates, E.; Benigni, L.; Bretherton, I.; Camaioni, L.; Volterra, V. The emergence of symbols: cognition and communication in infancy. New York: Academic Press; 1979.

Bayley, N. Bayley Scales of Infant and Toddler Development. 3rd Edition. San Antonio, TX: Psychological Corporation; 2005.

Bono MA, Daley T, Sigman M. Relations among joint attention, amount of intervention and language gain in autism. Journal of Autism and Developmental Disorders. 2004; 34(5):495–505. [PubMed: 15628604]

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

Dawson G, Adams A. Imitation and social responsiveness in autistic children. Journal of Abnormal Child Psychology. 1984; 12(2):209–226. [PubMed: 6725782]

Fiese BH. Playful relationships: A contextual analysis of mother-toddler interaction and symbolic play. Child Development. 1990; 61:1648–1656. [PubMed: 1700947]

Hwang B, Hughes C. Increasing early social-communicative skills of preverbal preschool children with autism through social interactive training. The Journal of The Association for Persons with Severe Handicaps. 2000; 25(1):18–28.

Iacoboni M, Mazziotta JC. Mirror neuron system: basic findings and clinical applications. Annals of neurology. 2007; 62(3):213–218. [PubMed: 17721988]

Ingersoll B. The social role of imitation in autism: Implications for the treatment of imitation deficits. Infants & Young Children. 2008a; 21(2):107–119.

Ingersoll B. The effect of context on imitation skills in children with autism. Research in Autism Spectrum Disorders. 2008b; 2(2):332–340.

Ingersoll B, Gergans S. The effect of a parent-implemented imitation intervention on spontaneous imitation skills in young children with autism. Research in Developmental Disabilities. 2007; 28(2):163–175. [PubMed: 16603337]

Ingersoll B, Lewis E, Kroman E. Teaching the imitation and spontaneous use of descriptive gestures in young children with autism using a naturalistic behavioral intervention. Journal of Autism and Developmental Disorders. 2007; 37(8):1446–1456. [PubMed: 17033930]

Ingersoll B, Schreibman L. Teaching reciprocal imitation skills to young children with autism using a naturalistic behavioral approach: effects on language, pretend play, and joint attention. Journal of Autism and Developmental Disorders. 2006; 36(4):487–505. [PubMed: 16568355]

Kasari C, Freeman S, Paparella T. Joint attention and symbolic play in young children with autism: a randomized controlled intervention study. Journal of Child Psychology and Psychiatry. 2006; 47(6):611–620. [PubMed: 16712638]

Kasari C, Paparella T, Freeman S, Jahromi LB. Language outcome in autism: Randomized comparison of joint attention and play interventions. Journal of Consulting and Clinical Psychology. 2008; 76(1):125–137. [PubMed: 18229990]

Klinger, LG.; Dawson, G. Facilitating early social and communicative development in children with autism. In: Warren, SF.; Reichle, JE., editors. Causes and effects in communication and language intervention. Vol. Vol 1. Baltimore, MD: Paul H. Brookes; 1992. p. 157-186.

Lord C, Risi S, Lambrecht L, Cook EH, Leventhal BL, DiLavore PC, et al. The Autism Diagnostic Observation Schedule—Generic: A standard measure of social and communication deficits associated with the spectrum of autism. Journal of Autism and Developmental Disorders. 2000; 30(3):205–223. [PubMed: 11055457]

Lovaas OI, Freitas L, Nelson K, Whalen C. The establishment of imitation and its use for the development of complex behavior in schizophrenic children. Behaviour Research and Therapy. 1967; 5(3):171–181. [PubMed: 6063525]

McDuffie A, Turner L, Stone W, Yoder P, Wolery M, Ulman T. Developmental correlates of different types of motor imitation in young children with autism spectrum disorders. Journal of autism and developmental disorders. 2007; 37(3):401–412. [PubMed: 16900404]

Meltzoff AN, Moore MK. Imitation of facial and manual gestures by human neonates. Science. 1977; 198(4312):75–78. [PubMed: 17741897]

Metz J. Conditioning generalized imitation in autistic children. Journal of Experimental Child Psychology. 1965; 4:389–399.

Nadel, J. Imitation and imitation recognition: Functional use in preverbal infants and nonverbal children with autism. In: Meltzoff, AN.; Prinz, W., editors. The imitative mind: development, evolution and brain bases. Cambridge, UK: Cambridge University Press; 2002. p. 42-32

Rogers SJ, Hepburn SL, Stackhouse T, Wehner E. Imitation performance in toddlers with autism and those with other developmental disorders. Journal of Child Psychology & Psychiatry & Allied Disciplines. 2003; 44(5):763–781.

Sallows GO, Graupner TD. Intensive behavioral treatment for children with autism: four-year outcome and predictors. Am J Ment Retard. 2005; 110(6):417–438. [PubMed: 16212446]

Schreibman L, Kaneko WM, Koegel RL. Positive affect of parents of autistic children: A comparison across two teaching techniques. Behavior Therapy. 1991; 22(4):479–490.

Seibert JM, Hogan AE, Mundy PC. Assessing interactional competencies: The early social-communication scales. Infant Mental Health Journal. 1982; 3(4):244–245.

Sherer MR, Schreibman L. Individual behavioral profiles and predictors of treatment effectiveness for children with autism. Journal of Consulting and Clinical Psychology. 2005; 73(3):525–538. [PubMed: 15982150]

Sigman M, Ungerer JA. Cognitive and language skills in autistic, mentally retarded, and normal children. Developmental Psychology. 1984; 20(2):293–302.

Smith IM, Bryson SE. Imitation and action in autism: A critical review. Psychological Bulletin. 1994; 116:259-259. [PubMed: 7526410]

Snow CE. Imitativeness: A trait or a skill. The many faces of imitation in language learning. 1989:73–90.

Stone WL, Ousley OY, Littleford CD. Motor imitation in young children with autism: What's the object? Journal of Abnormal Child Psychology. 1997; 25(6):475–485. [PubMed: 9468108]

Stone WL, Yoder PJ. Predicting spoken language level in children with autism spectrum disorders. Autism. 2001; 5(4):341–361. [PubMed: 11777253]

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Toth K, Munson J, N Meltzoff A, Dawson G. Early predictors of communication development in young children with autism spectrum disorder: Joint attention, imitation, and toy play. Journal of Autism and Developmental Disorders. 2006; 36(8):993–1005. [PubMed: 16845578]

Ungerer JA, Sigman M. Symbolic play and language comprehension in autistic children. Journal of the American Academy of Child Psychiatry. 1981; 20(2):318–337. [PubMed: 6167603]

Uzgiris, IC.; Lewis, M.; Feinman, S. Social influences and socialization in infancy. New York: Plenum Press; 1990. The social context of infant imitation; p. 215-251.

Williams JHG, Whiten A, Singh T. A systematic review of action imitation in autistic spectrum disorder. Journal of Autism and Developmental Disorders. 2004; 34(3):285–299. [PubMed: 15264497]

Yoder P, Compton D. Identifying predictors of treatment response. Mental retardation and developmental disabilities research reviews. 2004; 10(3):162–168. [PubMed: 15611985]

Zimmerman, IL.; Steiner, VG.; Pond, RE. Preschool Language Scale. 4th Edition. San Antonio, TX: The Psychological Corporation; 2002.

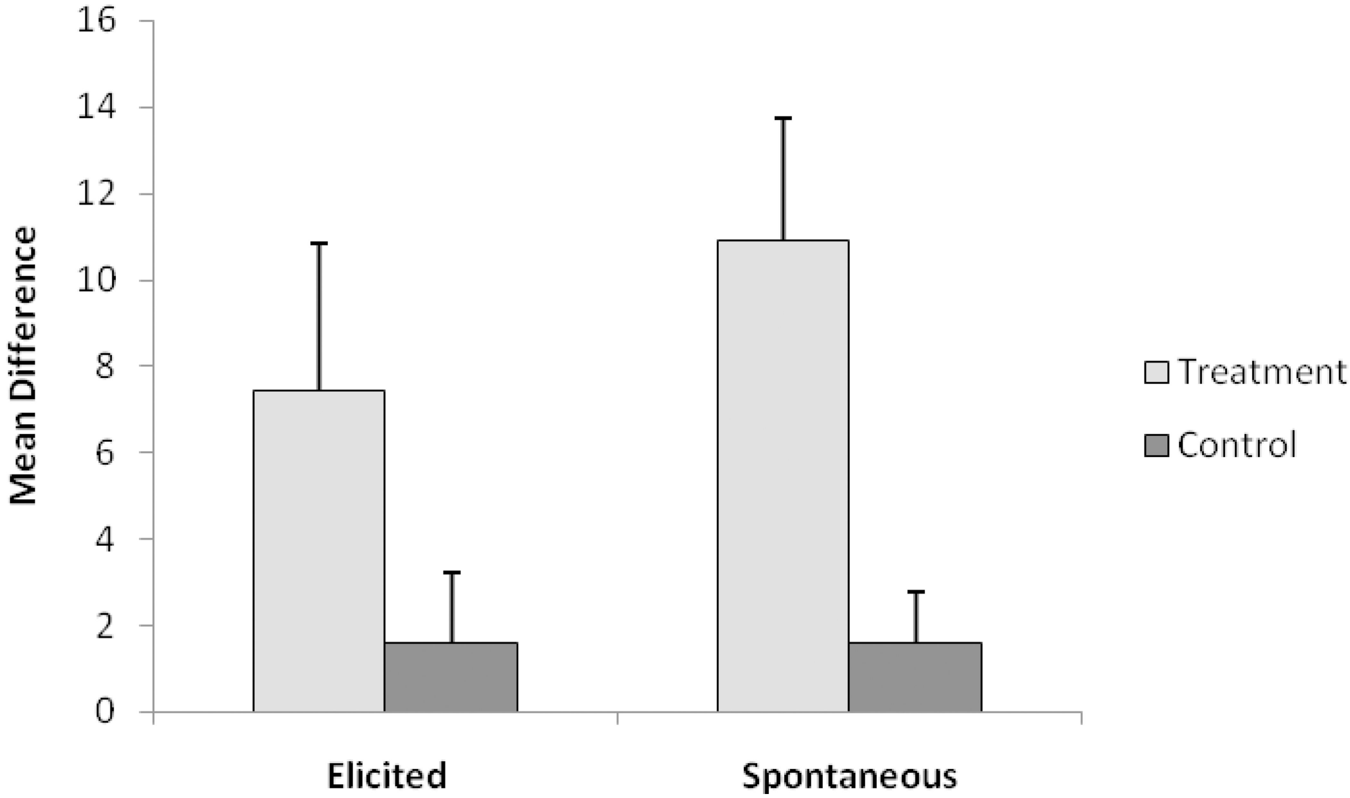

Figure 1.
Mean Difference in Elicited and Spontaneous Imitation Performance from Pre- to Post-Treatment by Group

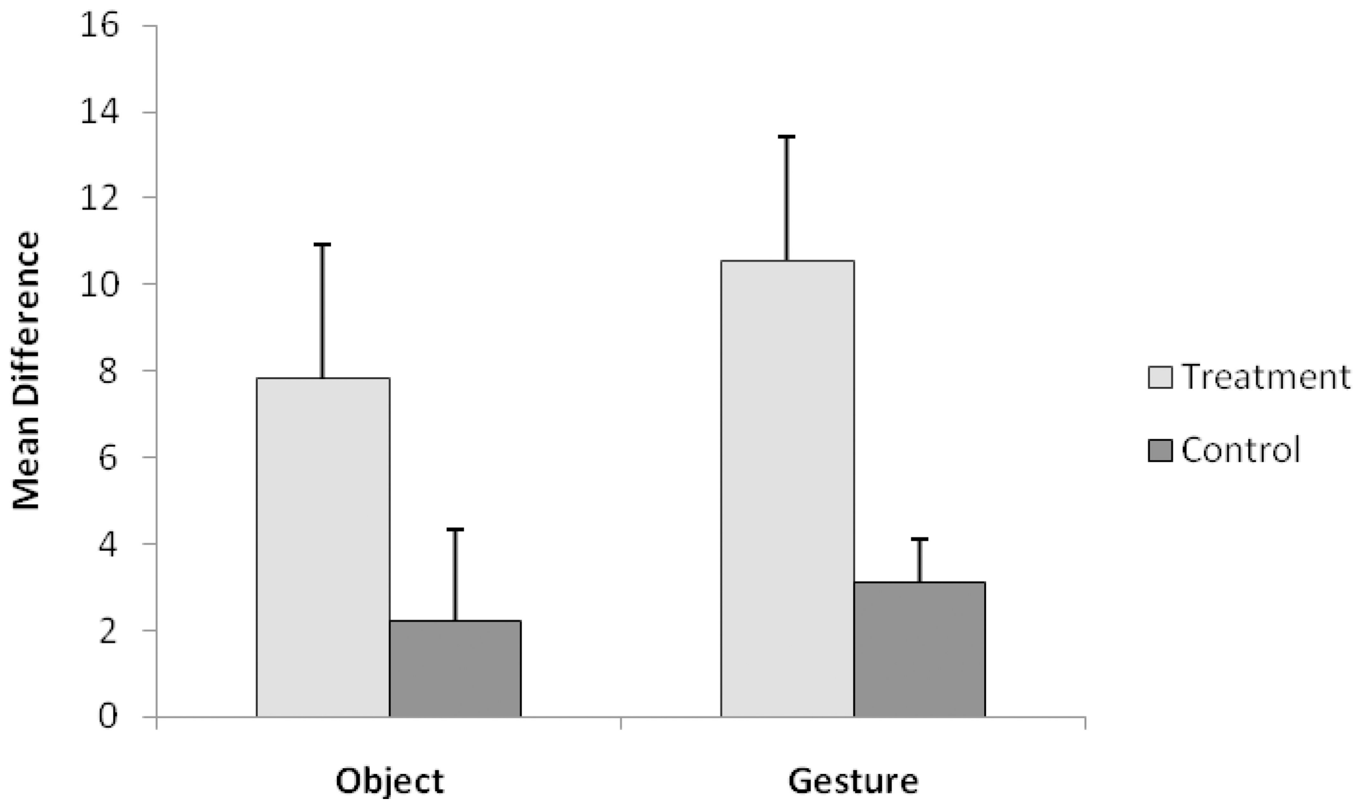

Figure 2.
Mean Difference in Object and Gesture Imitation Performance from Pre- to Post-Treatment by Group

Table 1

Participant Characteristics

	Group M (SD)		P-Value
	Treatment (n=11)	**Control (n=10)**	
Gender (% Male)	90%	80%	*n.s.*
Ethnicity (% Minority Status)	36%	40%	*n.s.*
Chronological Age	41.36 (4.30)	37.20 (7.36)	*n.s.*
Nonverbal Mental Age (Bayley)	21.73 (6.12)	18.60 (6.02)	*n.s.*
Language Age (PLS-4)	15.91 (4.76)	14.50 (4.53)	*n.s.*
Number of Spontaneous Play Acts (SPA)	30.27 (19.43)	20.10 (13.35)	*n.s.*
Response to Joint Attention (ESCS)	51.72 (22.90)	49.50 (24.37)	*n.s.*
Initiation of Joint Attention (ESCS)	2.73 (2.72)	2.10 (3.25)	*n.s.*
Hours of Outside Intervention per Week	12.41 (8.21)	15.33 (8.21)	*n.s.*
Elicited Imitation (MIS)			
Pre	13.18 (10.20)	5.60 (5.46)	.05
Post	20.64 (11.40)	7.20 (6.65)	.004
Spontaneous Imitation (UIA)			
Pre	6.36 (4.57)	3.10 (2.33)	*n.s.*
Post	17.27 (11.56)	4.70 (3.83)	.005

Table 2

Sample Items from the Imitation Assessments

	Motor Imitation Scale	**Unstructured Imitation Assessment**
Object Imitation	Walk dog across table.	Put boa around neck. “I have a scarf.”
	Place block on head.	Turn sound tube upside down 2 times. “Wheee!”
Gesture Imitation	Wave hand.	Clap hands. “Oh no!”
	Open and close fist.	Put finger to lips. “Shh. Baby’s sleeping”

Table 3

Correlations between Pre-Treatment Characteristics and Change in Imitation Scores for Treatment Group (n=11)

	Elicited Imitation	Spontaneous Imitation	Object Imitation	Gesture Imitation
Non-verbal Mental Age	.25	.26	.24	.31
Verbal Mental Age	.15	.16	.11	.22
Number of Spontaneous Play Acts	.44$	.54*	.51+	.54*
Response to Joint Attention	−.09	.32	−.12	.34
Initiation of Joint Attention	−.06	.36	.10	.20

*p<.05, one-tailed

+p=.06, one-tailed

$p=.07, one-tailed