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A Randomized Trial Comparison of the Effects of Verbal and Pictorial Naturalistic Communication Strategies on Spoken Language for Young Children with Autism

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Abstract Presently there is no consensus on the specific behavioral treatment of choice for targeting language in young nonverbal children with autism. This randomized clinical trial compared the effectiveness of a verbally-based intervention, Pivotal Response Training (PRT) to a pictorially-based behavioral intervention, the Picture Exchange Communication System (PECS) on the acquisition of spoken language by young (2–4 years), nonverbal or minimally verbal (≤ 9 words) children with autism. Thirty-nine children were randomly assigned to either the PRT or PECS condition. Participants received on average 247 h of intervention across 23 weeks. Dependent measures included overall communication, expressive vocabulary, pictorial communication and parent satisfaction. Children in both intervention groups demonstrated increases in spoken language skills, with no significant difference between the two conditions. Seventy-eight percent of all children exited the program with more than 10 functional words. Parents were very satisfied with both programs but indicated PECS was more difficult to implement.

Keywords Autism · Behavioral intervention · Functional communication · Vocal language intervention · Pictorial communication intervention · Augmentative communication

Introduction

Recently the importance of early intervention (i.e., treatment before the age of 4 years) has been heavily emphasized in the treatment of autism (Dawson 2008). Indeed, recent literature estimates that from 20 to 50 % of children with autism fail to ever acquire spoken language (Tager-Flusberg et al. 2005). Achieving spoken language by age 5–6 years is associated with better long-term outcomes in ASD (National Research Council 2001). Because early intervention is likely to impact spoken language, examination of methods to facilitate language development in young, nonverbal children with autism is extremely important. However, there is no consensus on the specific behavioral treatment model of choice for targeting communication in these children (National Research Council 2001). Although different treatment models have been developed and separately empirically validated as effective in teaching communication skills, few have been directly compared in a controlled study.

One widely used and manualized approach to teaching spoken language is Pivotal Response Training (PRT), a naturalistic behavioral intervention with strong empirical support (e.g., Koegel et al. 1987). Using PRT for children with ASD results in language improvements and concomitant decreases in inappropriate and disruptive behaviors (Koegel et al. 1992). PRT has been shown to be effective for improving speech imitation (Koegel et al. 1998; Laski et al. 1988), labeling (Koegel et al. 1998), spontaneous speech

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(Laski et al. 1988), and rapid acquisition of functional speech in previously nonverbal children (Sze et al. 2003). However, the failure of many individuals with autism to acquire language using verbally-based treatment methods has led to use of alternative augmentative communication systems. The most widely used of these approaches, the Picture Exchange Communication System (PECS; Bondy and Frost 2001) also enjoys empirical support and teaches individuals to exchange picture icons to communicate. We have known that children with autism can learn to use augmentative systems to communicate (Mirenda and Iacono 1988) and that use of an augmentative system offers a functional system until spoken language is developed. Further it has been posited that the acquisition of such a system reduces behavioral difficulties and actually facilitates language acquisition (Bondy and Frost 2001). Several studies have found that the use of PECS increases spoken communication in some children with ASD (e.g., Charlop-Christy et al. 2002; Ganz et al. 2007; Yoder and Stone 2006a). Ronski et al. (2010) reported that augmented language interventions facilitated, rather than hindered, speech production abilities in young children with developmental delays.

The primary difference between these approaches is that PRT teaches communication through verbal strategies and PECS through pictorial methods. However, only two reports (presenting data for the same set of participants) have systematically compared differential effects of verbally and visually-based communication programs for young children with autism. Yoder and Stone (2006a, b) conducted a randomized comparison of a verbally-based naturalistic intervention, responsive education and prelinguistic milieu teaching (RPMT) to PECS. Results indicated that PECS, on average, was superior to RPMT for improving children’s spoken communication/spoken language, although results varied depending upon child characteristics. Additional data are needed to determine whether PECS, on average, tends to be superior to other naturalistic behavioral interventions for fostering spoken language in this population.

The present investigation included a direct comparison of spoken language outcomes for young, minimally verbal children with autism taught communication using either PECS or PRT. Both interventions are empirically supported and both are commonly used in community treatment settings.

Method

Participants

Participants included referrals to two university-based autism research programs who met the following criteria: (a) diagnosis of Autistic Disorder (APA 2000) as confirmed

by administration of the Autism Diagnostic Interview—Revised (ADI-R; Lord et al. 1994), and the Autism Diagnostic Observation Schedule—Generic (ADOS-G; Lord et al. 2000), (b) under 48 months old, (c) no more than nine intelligible words (d) absence of evidence for diagnosis of primary mental retardation, neurological pathology or major sensory impairment, (e) absence of prior treatment involving either PECS or PRT, and (f) parental willingness to participate in parent training and to refrain from the non-assigned treatment during the duration of the study. Monthly contact between the research team and outside providers and weekly discussion with parents indicated that no parents used the non-assigned treatment. Parents were offered training in the alternative condition at the end of the study.

Forty-one families met the eligibility criteria, however two families (one each per site, one each per condition) discontinued participation during the first several weeks of treatment. One family moved out of the area and one family chose to receive the nonassigned condition. Thirty-nine children (34 male, 5 female) between 20 and 45 months (M = 29.21, SD = 5.67) participated in the study with 20 children in the PRT condition and 19 in the PECS condition. The child’s primary caregiver participated in parent education (32 mothers, 7 fathers). Seventeen children participated at University Site 1 and 22 at University Site 2. Table 1 presents demographic information by treatment condition. There were no statistically significant differences between treatment conditions in any of the tested variables at intake (see Table 1).

Table 1 Child demographic variables at pre-treatment

Variables	PECS (n = 19)	PRT (n = 20)	Whole sample (N = 39)
Age in months	28.9 (4.2) ^a	29.5 (6.9) ^a	29.2 (5.67) ^a
Gender			
Male	16 (84.2 %)	18 (90.0 %)	34 (87.2 %)
Female	3 (15.8 %)	2 (10.0 %)	5 (12.8 %)
Campus			
University site 1	9 (47.4 %)	8 (40.0 %)	17 (43.6 %)
University site 2	10 (52.6 %)	12 (60.0 %)	22 (56.4 %)
Words use			
No words	11 (57.9 %)	10 (50.0 %)	21 (53.8 %)
1–10 words	8 (42.1 %)	10 (50.0 %)	18 (46.2 %)
Cognitive functioning			
Low	8 (42.1 %)	12 (60.0 %)	20 (51.3 %)
High	11 (57.9 %)	8 (40.0 %)	19 (48.7 %)

Numbers are frequency (percent of treatment condition sample) unless otherwise noted

^a Numbers are M (SD)

Experimental Design and Procedure

Children were randomly assigned to PRT or PECS using a stratified randomization procedure. Children were matched on three, two-level factors: word use (no words or 1–9 functional words), age (18–32 mos or 33–47 mos) and cognitive functioning (low or high). A child was categorized as having no words if he or she was reported to have used no words communicatively on the Vineland Adaptive Behavior Scales (VABS; Sparrow and Cicchetti 1989) and observed to use no words the Mullen Scales of Early Learning (MSEL; Mullen 1995), Autism Diagnostic Observation Schedule (ADOS; Lord et al. 2000), Expressive One-Word Picture Vocabulary Test (EOWPVT; Gardner 1990), and a 25-min parent–child observation. A child was categorized as having some words if he or she was reported or observed to have used any words communicatively on any of the above measures at intake. Cognitive functioning was assessed using the visual reception subscale of the Mullen Scales of Early Learning (MSEL; Mullen 1995). Age-adjusted visual reception scores were derived by dividing a child's visual reception age equivalent (AE) score by chronological age and multiplying by 100. Low cognitive functioning was defined as an adjusted score of less than or equal to 50; high cognitive functioning was defined as an adjusted score of >50.

For every two children assessed that were matched on all variables, one was randomly assigned to PRT or PECS and the other to the alternative condition. Dependent measures were obtained at program entry, post intervention, and after a 3-month follow up period during which no intervention was provided.

Treatment Description and Fidelity of Implementation

Child participants were scheduled to receive a total of 258 h of treatment with either PRT or PECS. During the course of the study children actually received an average of 247 h of treatment (range = 181–263). For the first 15 weeks, parents participated in 2 weekly, 2-h parent education sessions with their child in the laboratory and children received an additional five 2-h sessions per week in the home. This was followed by 8 weeks of one 2-h parent education session per week and two 2-h sessions per week in the home. Procedures for both conditions were based on their respective treatment manuals (Frost and Bondy 2002; Koegel et al. 1989).

In-Home Treatment

Undergraduate student therapists trained in PECS and PRT provided the intervention to the children. Therapists were trained to criterion (80 % correct usage of all treatment

components over two treatment sessions) on treatment fidelity of implementation. Fidelity of implementation was tracked after every 10 h of intervention provided by each therapist. Therapy sessions were videotaped and later coded for fidelity of implementation by a coder blind to the study hypotheses. Therapists were not aware of which sessions would be evaluated for fidelity of implementation. If a therapist fell below the 80 % criterion, they were removed from treatment and re-trained to criterion (this occurred only once). *Parent education.* Parent educators were doctoral students well experienced in autism and the use of PRT and PECS. All parent educators met criterion for fidelity of implementation for both interventions. Criterion for fidelity of implementation was a minimum of 80 % correct usage of all treatment components. Parent education consisted of reading the assigned manual (PECS or PRT), direct one-on-one review of therapeutic procedures and exercises in the manuals, and multiple practice sessions with modeling and feedback.

Intervention

Both PRT and PECS use motivation and child initiation as a basis for facilitating communication and are based on the principles of applied behavior analysis. Specifically, both interventions provide natural opportunities for communication (e.g., communication temptations), require a response from the child, and use direct reinforcement (reinforcement directly related to the child's response) to increase responding. Although both treatment packages included similar materials (with the exception of PECS specific picture cards) and were delivered at similar intensity, the specific mode of the two treatment conditions varied. That is, families in the PRT condition were taught to use motivational techniques to facilitate verbal communication in their children, while families in the PECS condition were taught to use similar techniques to facilitate augmentative communication in their children.

Pivotal Response Training (PRT)

Parents and therapists were trained to target the development and spontaneous use of functional spoken language. Training followed the sequence of the PRT training manual (Koegel et al. 1987). The reader is directed to the manual for a more detailed description of treatment guidelines.

Picture Exchange Communication System (PECS)

Parents and therapists were trained to teach children to use picture icons to communicate. Training followed the sequence of the PECS training manual (Frost and Bondy 2002). Procedures, in accordance with the manual,

included the use of a cloze procedure (e.g., “I want _____”) as a prompt for the child to engage in spoken language during later phases of the intervention. The reader is directed to the manual for a more detailed description of treatment guidelines.

Outside Interventions

To further characterize the children’s intervention and to establish that the two groups did not differ systematically from one another, we kept track of the amount and type of outside treatments the participants received. Number of hours weekly of outside speech therapy, occupational therapy, preschool/daycare, and in-home early intervention were monitored via parental report.

Setting and Materials

Parent education was conducted in small playrooms that included a variety of toys specific to the child’s preferences and developmental level. A generalization setting at each site contained a sofa, chairs and a coffee table. No intervention occurred in the generalization setting. Child treatment was conducted in the child’s home.

Dependent Measures

Spoken Language

The Mullen Scales of Early Learning (MSEL; Mullen 1995) measures cognitive ability in a variety of domains for children ages birth to 68 months. For the purposes of this study we examined data from the expressive language scale, with a mean of 50 and standard deviation of 10, and the early learning composite with a mean of 100 and a standard deviation of 15.

Spoken Vocabulary

Children were assessed using a standardized measure of spoken vocabulary, the Expressive One-Word Picture Vocabulary Test-Revised (EOWPVT; Gardner 1990) which provides a measure of a child’s expressive vocabulary with respect to population norms. Standardized scores are available with a mean of 100 and standard deviation of 15. A large majority of children in our sample (i.e., 37) were unable to establish a basal score. To facilitate appropriate analyses of the data, children were categorized based on scores falling into one of five ordinal categories that correspond with the assessments’ normal distributions (No score, 55–70, 71–85, 86–100, >100). Parents completed the MacArthur Communicative Developmental

Inventory (CDI; Fenson et al. 2006), a standardized parent report instrument of early language competence that measures both receptive and expressive communication. Raw scores for words produced on this vocabulary checklist were utilized, as standard scores are not available for this assessment.

Adaptive Communication

Parents completed the Vineland Adaptive Behavior Scales, 2nd Ed, (VABS; Sparrow and Cicchetti 1989), a standardized measure used to assess the child’s competence and independence in his/her daily living environment. Our analyses included standardized scores with a mean of 100 and standard deviation of 15 in only the communication subdomain.

Augmentative Communication

The phase of PECS being taught at the end of treatment was used as a measure of augmentative communication for children assigned to the PECS condition. Children received a score of 1 through 6 depending upon which phase they were currently learning (but had not yet mastered).

Parent Satisfaction

At post intervention parents completed a satisfaction survey consisting of questions regarding their overall impressions of the program including program effectiveness, intervention techniques, child improvements, and the parent education format. Each area had several questions and parents were asked to rate each question on a scale of 1–7.

All intake assessments and dependent measures were administered by trained staff. Dependent measures were completed at pre-treatment, post-treatment and at a 3-month follow-up. Staff conducting the assessments were not involved in provision of intervention for the child they assessed. Three-quarters of ADOS assessments were scored by blind coders from an outside research laboratory (i.e., naïve as to assigned condition) across sites, time points and condition. These coders had specialized expertise in the administration and scoring of this instrument. All assessors were blind to condition for pre-treatment assessments as random assignment was conducted after intake assessments were complete. Half of all intake and dependent assessments conducted at Site 1 were conducted by assessors blind to condition at post and follow-up. While blind assessments were not conducted at Site 2, there were no across-site differences in scores by group or time period across the sites.

Table 2 Children's mean scores on standardized assessments at program entry and exit

	Pre treatment mean (SD)		Post treatment mean (SD)		Follow-up mean (SD)	
	PECS	PRT	PECS	PRT	PECS	PRT
<i>Mullen Scales of Early Learning (n = 38)</i>						
Expressive communication subtest (SS) M = 50 SD = 10						
Expressive comm.	20.3 (3.2)	18.5 (2.8)	26.7 (12.7)	22.5 (7.0)	28.7 (16.5)	23.7 (11.2)
MacArthur CDI (n = 35) raw number of words						
Words produced	5.3 (9.4)	11.9 (20.5)	88.7 (105.5)	83.2 (88.3)	129.8 (117.9)	113.3 (108.3)
Vineland Adaptive Behavior Scales (n = 35) (SS) M = 100 SD = 15						
Communication	62.2 (4.7)	60.2 (7.5)	67.1 (14.9)	59.7 (9.6)	68.4 (14.5)	62.6 (12.7)

Results

Main and Interaction Effects of Time and Treatment

Results are summarized in Table 2. A per protocol analysis was followed, resulting in the exclusion of the two participants who were initially enrolled in the study but discontinued. No data beyond pre-treatment assessments were available for either participant. Standardized assessment gains were analyzed with a 3×2 (Time \times Treatment) mixed model repeated measures ANOVA with Greenhouse-Geisser correction for all measures except the EOWPVT. Type I error probability was maintained at .05 (two-tailed) for all analyses. Main and interaction effects of time and treatment condition were analyzed. Means by condition and time period are listed in Table 2. Gains on the EOWPVT were analyzed with a 3×2 (Time \times Treatment) ordinal mixed factor model. At intake, 95 % of children in both groups received no basal score on the EOWPVT. At exit, approximately 50 % of children (range = 45–53 %) obtained a basal and completed the assessment. The frequencies for each category by condition are available from the authors.

Since results for all of the assessments in the ANOVA followed the same pattern when analyzed separately (significant effects of Time within each treatment group with

no Group \times Time interaction), we collapsed results for both conditions across time period. *F.* and *p*-values, and effect sizes presented in Table 3. Chi square and *p*-values for the EOWPVT are also presented in Table 3.

For each dependent measure, a main effect of time indicated improvement in child behavior in areas of spoken language, adaptive communication, and spoken vocabulary. When collapsed across conditions, gains on each of these assessments from pre-treatment to post-treatment to follow up were statistically significant. In many cases, effect sizes were quite large, especially for vocabulary, the main target of the intervention. There was no main effect of treatment type for any assessments. No Time \times Treatment interaction was found. Standard deviations were quite large for a majority of measures indicating a heterogeneous set of individual response patterns in both conditions.

Augmentative Communication—PECS Phase

Of the 19 children in the PECS condition, 12 reached Phase 6, that is, they had mastered requesting and were learning to comment using pictures. Two children reached Phase 5 (responding and attributes), two reached Phase 4 (requesting items using a sentence strip), two reached Phase 3 (learning to discriminate pictures), and one reached Phase 2. The three children in Phases 2 and 3 were not

Table 3 Statistical analyses of change over time and across conditions

	Time <i>F</i> , <i>p</i> , Effect size ^a	Treatment <i>F</i> , <i>p</i>	Time \times Treatment <i>F</i> , <i>p</i>
Mullen Scales of Early Learning (n = 38)			
Expressive comm.	9.95, .000, .216	1.775, .191	.551, .510
MacArthur CDI (n = 35)			
Words produced	31.26, .000, .486	.045, .833	.313, .645
Vineland Adaptive Behavior Scales (n = 35)			
Communication	4.09, .037, .110	2.263, .142,	1.765, .190
Expressive One Word Picture Vocabulary Test (n = 39 pre/post and 37 at follow-up; <i>Chi-sq</i> : <i>df</i> : <i>p</i>)			
	26.637, 2, .001	.490, 1, .484	.027, 2, .987

^a Effect sizes are reported for significant results only

using spoken language to communicate. Of the children who reached Phase 4 or higher, all but four of them (one in Phase 4 and three in Phase 6) were reported to have more than 10 words on the CDI. Of the children who reached Phase 6, five of them had expressive language age equivalent scores on the MSEL of less than 12 months, indicating the possibility that their complexity of communication was higher when using PECS.

Parent Satisfaction

Parents were satisfied with the intervention overall, with mean ratings of 5.7 (1 being very dissatisfied and 7 being very satisfied) for PRT and 6.0 for PECS. Overall improvement across all areas of communication, self help skills, and behavior was moderate with mean ratings of 4.4 for PRT and 4.5 for PECS (1 being no improvement and 7 extreme improvement). Parents rated the general teaching format and usefulness of the program highly at 6.3 for PRT and 6.3 for PECS (1 being not useful and 7 being very useful). Parents rated the specific intervention strategy difficulty at 5.6 for PRT and 4.6 for PECS (1 being very difficult and 7 being not difficult). Difficulty of the intervention strategies was the only statistically significant difference between PRT and PECS ($F(1,28) = 9.413$, $p = .005$).

Outside Interventions

We conducted analyses of weekly number of hours the participants received other treatment while participating in this investigation. *T* test analyses of speech therapy and occupational therapy (PRT: .94 h/week, PECS: .94 h/week), preschool/daycare (PRT: .3, PECS: 1.5) and in-home early intervention (PRT: 2.4, PECS: 3.4) indicated no significant difference in the amount of these treatments received across the two conditions.

Discussion

This study provided a systematic, randomly controlled comparison of two empirically-validated behavioral treatments, PRT and PECS. Due to the lack of a usual care control group we cannot draw conclusions regarding the relationship between gains in spoken language and either of the treatment conditions. One intervention modality was not superior to the other. Results indicate that based on mean scores, the 2- to 3-year-old, nonverbal and minimally verbal children in both the PRT and PECS conditions made similar gains in spoken communication. On average, children gained approximately 80 spoken words across the 6-month study period, although we found extreme

variability in the verbal progress of enrolled children. At the final measurement period, 78 % of the children across both treatment groups, were reported to use at least 10 spoken words.

In the PECS condition 79 % of children learned to use the system functionally and reached Phase 6 (commenting). Although each of the PECS phases is not specifically associated with a typical age equivalent, the commenting phase requires skills similar to those seen in typically developing children's spoken language at approximately 15–20 months. Approximately 42 % of the children in the PECS condition may have been using their picture system in a more complex manner than their spoken language. However, this needs to be explored further in future research to examine generalization of skills and use of specific types of communicative functions. Similar to other studies, (e.g., Charlop-Christy et al. 2002) children in the PECS condition often began to use spoken language once they reached Phase 4, which includes the use of cloze procedures and expectant waiting for speech production.

Parents in both groups were satisfied with the intervention and reported progress in their children. However, parents found PECS to be more difficult to implement in the home. Perhaps the more effort required to prepare PECS icons, prepare PECS books and having to ensure the child had his PECS book with him, etc., contributed to this reported increased difficulty. This is in contrast to PRT where materials in the current, natural environment were all that was required.

Reportedly, some parents and practitioners have been reluctant to recommend augmentative communication systems for children with autism, fearful that these systems may interfere with the development of spoken language. Given the randomized comparison design, these findings suggest that PECS may be as effective as naturalistic verbal language training programs such as PRT for facilitating language. It is noteworthy that PECS did not inhibit growth in spoken language. However, due to the variability in child progress these data also raise questions regarding when to use which methodology. It is hoped future research in this area will assist our efforts to individualize treatment protocols in this area.

As was expected, average change on standardized assessments misrepresented a wide variability of treatment response. Children receiving PECS and PRT shared a strikingly similar pattern of responsiveness for spoken language outcomes. A unique contribution of the present study, as compared to most previous treatment studies, is that many of the participants were under 3 years of age and minimally verbal. Given that even at this early age, approximately 50 % of children had good outcomes while others made slower progress, it may be that alternative strategies are needed for these children to jump-start their

progress. Further studies and further analyses of the current data set will examine the specific predictors of positive outcomes in an effort to determine whether child characteristics may indicate differential responding to either intervention.

In the only other direct comparison of PECS and a naturalistic behavioral verbally-based approach (RPMT), Yoder and Stone (2006a, b) found a main effect in favor of PECS for spoken vocabulary measures in a similar sample of participants as the present study. This contrasts our findings of no difference between the conditions. It is interesting to speculate as to why we failed to replicate Yoder and Stone's (2006a, b) findings. One possibility is that the participants in the studies differed on some key characteristics (object exploration, social initiation, avoidance) that were not assessed in the current work. It is also possible that the different measures utilized in the current study (i.e., natural language samples versus standardized measures and parent report) may have contributed to the failure to find a main effect for condition. Given that to date there have been so few randomized clinical trials of these communication interventions it is likely that further research directed at these important questions will yield clarification of these, as well as other, issues.

There are some limitations to this study. As noted above the present study did not include a no-treatment control group. Therefore treatment gains may have been due to development rather than a function of either intervention. Further research will be necessary in order to address whether gains maintained across time and environments. This study was limited to only nonverbal and minimally verbal young children with autism and therefore may not generalize to children who are verbal at a young age. A subset of assessments was conducted by coders who were aware of the treatment condition, which represents a threat to the internal validity of the findings.

Conclusions

The results of this study suggest that a majority of young, nonverbal or minimally verbal children with autism will learn to use spoken language at a young age. This is a very promising finding that is consistent with current early intervention literature. These findings indicate that PECS and PRT may both be useful in improving children's communication, however further study is needed due to the lack of differences between the groups. The PECS system did not appear to inhibit or facilitate the development of spoken communication. Decisions regarding whether to recommend one system over another will likely ultimately be determined by research focusing on generalization and maintenance of communication gains, and the point in

treatment when change to the other system should be considered. Further, an important variable in this decision will undoubtedly be child characteristics associated with success with either system. For example, Yoder and Stone (2006a) found that PECS was superior for the development of nonimitative words for children who entered treatment with higher levels of object exploration while RPMT was superior for children who entered with relatively low object exploration. Thus research focusing on child characteristics associated with response to these treatment modalities will serve to inform early intervention targeting communication in young minimally verbal children with autism and allow interventionists to provide more tailored interventions.

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References

- American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.
- Bondy, A. S., & Frost, L. A. (2001). The picture exchange communication system. *Behavior Modification*, *25*, 725–744.
- Charlop-Christy, M., Carpenter, M., Le, L., LeBlanc, L., & Kellet, K. (2002). Using the picture exchange communication system (PECS) with children with autism: Assessment of PECS acquisition, speech, social-communicative behavior, and problem behavior. *Journal of Applied Behavior Analysis*, *35*, 213–231.
- Dawson, G. (2008). Research: Early behavioral intervention, brain plasticity, and the prevention of autism spectrum disorder. *Development and Psychopathology*, *20*, 775–803.
- Fenson, L., Marchman, V., Thal, D., Dale, P., Reznick, S., & Bates, E. (2006). *MacArthur-Bates Communicative Development Inventories (CDIs)* (2 ed.): Brookes Publishing.
- Frost, L., & Bondy, A. (2002). *The picture exchange communication system training manual* (2nd ed.). Newark, Delaware: Pyramid Educational Products.
- Ganz, J. B., Simpson, R. L., & Corbin-Newsome, J. (2007). The impact of the picture exchange communication system on requesting and speech development in preschoolers with autism spectrum disorders and similar characteristics. *Research in Autism Spectrum Disorders*, *2*, 167–169.
- Gardner, M. F. (Ed.). (1990). *Expressive one-word picture vocabulary test*. Novato, CA: Academy Therapy Publications.
- Koegel, R., Camarata, S., Koegel, L., Ben-Tall, A., & Smith, A. (1998). Increasing speech intelligibility in children with autism. *Journal of Autism and Developmental Disorders*, *28*, 241–251.
- Koegel, R. L., Koegel, L. K., & Surratt, A. (1992). Language intervention and disruptive behavior in preschool children with autism. *Journal of Autism and Developmental Disorders*, *22*, 141–153.
- Koegel, R. L., O'Dell, M. C., & Koegel, L. K. (1987). A natural language teaching paradigm for nonverbal autistic children. *Journal of Autism and Developmental Disorders*, *17*, 187–200.

- Koegel, R. L., Schreibman, L., Good, A., Cerniglia, L., Murphy, C., & Koegel, L. K. (Eds.). (1989). *How to teach pivotal behaviors to children with autism: A training manual*. CA: Santa Barbara.
- Laski, K. E., Charlop, M. H., & Schreibman, L. (1988). Training parents to use the natural language paradigm to increase their autistic children's speech. *Journal of Applied Behavior Analysis, 21*, 391–400.
- Lord, C., Risi, S., Lambrecht, L., Cook, E. H. J., Leventhal, B. L., DiLavore, P. C., et al. (2000). 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, 30*, 205–223.
- Lord, C., Rutter, M., & Le Couteur, A. (1994). Autism diagnostic interview-revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders, 24*, 659–685.
- Mirenda, P., & Iacono, T. (1988). Strategies for promoting augmentative and alternative communication in natural contexts with students with autism. *Focus on Autism and Other Developmental Disabilities, 3*, 1–16.
- Mullen, E. (Ed.). (1995). *Mullen scales of early learning* (AGS ed.). Circle Pines, MN: AGS Publishing.
- National Research Council. (2001). *Educating children with autism*. Washington DC: National Academy Press.
- Romski, M., Sevcik, R. A., Adamson, L. B., Cheslock, M., Smith, A., Barker, R. M., et al. (2010). Randomized comparison of augmented and nonaugmented language interventions for toddlers with developmental delays and their parents. *Journal of Speech, Language, and Hearing Research, 53*, 350–364.
- Sparrow, S. S., & Cicchetti, D. V. (1989). The Vineland adaptive behavior scales. In C. S. Newmark (Ed.), *Major psychological assessment instruments* (Vol. 2, pp. 199–231). Needham Heights, MA: Allyn and Bacon.
- Sze, K., Koegel, R. L., Brookman, L., & Koegel, L. K. (2003). Rapid acquisition of speech in nonverbal children with autism: Developing typical, social, and communicative interactions in children with autism using pivotal response training and self-management. Paper presented at the Association for Behavior Analysis.
- Tager-Flusberg, H., Paul, R., & Lord, C. (2005). Language and communication in autism. In D. Cohen & F. Volkmar (Eds.), *Handbook of autism and pervasive developmental disorders* (3rd ed., Vol. 1, pp. 335–364). New Jersey: John Wiley and Sons Inc.
- Yoder, P., & Stone, W. L. (2006a). A randomized comparison of the effect of two prelinguistic communication intervention on the acquisition of spoken communication in preschoolers with ASD. *Journal of Speech, Language, and Hearing Research, 49*, 698–711.
- Yoder, P., & Stone, L. (2006b). Randomized comparison of two communication interventions for preschools with autism spectrum disorders. *Journal of Consulting and Clinical Psychology, 74*, 426–435.