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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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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, Paul & Lord, 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, O'Dell, & Koegel, 1987). Using PRT for children with ASD results in language improvements and concomitant decreases in inappropriate and disruptive behaviors (Koegel, Koegel, & Surratt, 1992). PRT has been shown to be effective for improving speech imitation (Koegel, Camarata, Koegel, Ben-Tall, & Smith, 1998; Laski, Charlop, & Schreibman, 1988), labeling (Koegel, et al., 1998), spontaneous speech (Laski, et al., 1988), and rapid acquisition of functional speech in previously nonverbal children (Sze, Koegel, Brookman, & Koegel, 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 (AAC). The most widely used of these approaches, the Picture Exchange Communication System (PECS; Bondy & 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 & 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 & Frost, 2001). Several studies have found that the use of PECS increases spoken communication in some children with ASD (e.g., Charlop-Christy, Carpenter, LeBlanc, & Kellet, 2002; Ganz, Simpson, Corbin-Newsome, 2007; Yoder & Stone, 2006). 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, Rutter & LeCouteur, 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 the 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 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).

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 to 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 & 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-minute 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 greater than 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 three-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 hours of treatment with either PRT or PECS. During the course of the study children actually received an average of 247 hours of treatment (range = 181–263). For the first 15 weeks, parents participated in two weekly, 2-hour parent education sessions with their child in the laboratory and children received an additional five 2-hour sessions per week in the home. This was followed by 8 weeks of one 2-hour parent education session per week and two 2-hour sessions per week in the home. Procedures for both conditions were based on their respective treatment manuals (Frost & Bondy, 2002; Koegel, Schreibman, Good, Cerniglia, Murphy, & Koegel, 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 hours 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 & 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 six 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, Marchman, Thal, Dale, Reznick, & Bates, 2006), a standardized parent report instrument of early language competence that measures both receptive and expressive communication was used as a measure of spoken vocabulary. 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 & 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 to 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.

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 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 hrs/wk, PECS: .94 hrs/wk), 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 responsivity 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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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%)

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

^aNumbers are M (SD).

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
Mullen Scales of Early Learning (n=38)						
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)

Table 3

Statistical Analyses of Change over Time and Across Conditions

	Time <i>F</i> , <i>p</i> , Effect Size ^{<i>I</i>}	Treatment <i>F</i> , <i>p</i>	Time × 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

^{*I*} Effect sizes are reported for significant results only.