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Randomized Comparison of Two Communication Interventions for Preschoolers With Autism Spectrum Disorders

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This randomized group experiment compared the efficacy of 2 communication interventions (Responsive Education and Prelinguistic Milieu Teaching [RPMT] and the Picture Exchange Communication System [PECS]) in 36 preschoolers with autism spectrum disorders. Each treatment was delivered 3 times per week, in 20-min sessions, for 6 months. The results revealed that the RPMT facilitated the frequency of generalized turn taking and generalized initiating joint attention more than did the PECS. The latter effect occurred only for children who began treatment with at least some initiating joint attention. In contrast, the PECS facilitated generalized requests more than the RPMT in children with very little initiating joint attention prior to treatment. These effect sizes were large.

Keywords: communication intervention, autism, initiating joint attention, randomized trial, efficacy study

Intentional communication involves conveying a message to another person by either (a) the use of gestures, vocalizations, and eye gaze combined with coordinated attention to an object and a person; or (b) the use of conventional gestures (e.g., distal points) or symbols (e.g., spoken words or sign language) (Yoder, McCathren, Warren, & Watson, 2001). The three major pragmatic functions used for intentional communication in the prelinguistic period are initiating joint attention, requesting, and turn taking (Wetherby, Cain, Yonclas, & Walker, 1988; Wetherby & Prutting, 1984). An example of initiating joint attention is clapping, smiling, and looking at the adult immediately after a block tower falls. An example of requesting is reaching for an out-of-reach ball and looking at the adult. An example of turn taking is putting a ball through a ball maze and then giving the ball to the adult during a predictable turn-taking routine.

The use of initiating joint attention (McEvoy, Rogers, & Pennington, 1993; Mundy, Sigman, & Kasari, 1990; Mundy, Sigman, Ungerer, & Sherman, 1986; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Wetherby & Prutting, 1984), requesting (Sigman & Ruskin, 1999), and turn-taking behavior (DiLavore, Lord, & Rutter, 1995) are often significantly impaired in young children with autism spectrum disorders (ASDs). Moreover, these three communicative behaviors have been linked to important developmental outcomes in children with ASD (McDuffie, 2004; Sigman & Ruskin, 1999; Stone & Yoder, 2001). Because social reciprocity is one of the core deficits of autism, some researchers have argued that improving turn taking and initiating joint attention may reduce the severity of ASD (e.g., Aldred, Green, & Adams, 2004; Mundy & Crowson, 1997).

Unfortunately, initiating joint attention is a communicative behavior that is notoriously difficult to teach to children with ASD. Presumably, the motivation to initiate joint attention is the acquisition of social attention and social connection (Mundy, 1995). True initiating joint attention acts occur in response to internal signals of interest or positive affect, not in response to verbal prompts such as "What do you see?" Moreover, the interventionist cannot provide the child with attention only when the child initiates joint attention. If she did, then children who rarely initiate joint attention, such as children with ASD, would rarely receive the interventionist's attention. Therefore, we cannot consistently control the antecedents (which are internal) or the consequences (which are social) of initiating joint attention in children with ASD. Only two single-subject reports have been published on attempts to teach initiating joint attention in children with ASD (Kasari, Freeman, & Paparella, 2000; Whalen & Schreibman, 2003). A randomized group experiment is needed to determine whether the apparent effects on initiating joint attention were because of the treatment. There are no treatment comparison studies to guide selecting among treatment options.

There is reason to believe that children can learn new communicative behaviors through requesting or turn taking and later generalize them to initiating joint attention. Leew (2001) found strong evidence that treatment affected the frequency of generalized initiating joint attention in 2 of 4 participants with develop-

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mental delays. Of interest, her data showed that the behaviors that were eventually used for generalized initiating joint attention (e.g., pointing, looking back and forth between the object and the communicative partner) were first used in the requesting function. This generalization may be particularly likely if newly acquired behaviors are demonstrated by the adult for use to initiate joint attention (Siller & Sigman, 2002).

One such therapeutic method is Responsive Education and Prelinguistic Milieu Teaching (RPMT). There has been no published research to date on the efficacy of the RPMT on turn taking. However, the RPMT directly teaches object exchange as a means of turn taking. Past research indicates that the RPMT is effective in facilitating requests in nonautistic children with developmental delays of mixed etiology and in facilitating initiating joint attention in children with developmental delays with initially low initiating joint attention (Yoder & Warren, 2002). Although this would seem to bode well for children with ASD, it should be noted that the children in this previous study initially used far more initiating joint attention than do most young children with ASD. It is not clear that the RPMT will facilitate initiating joint attention in children with extremely low motivation to communicate for attention or social connection.

Another communication intervention is the Picture Exchange Communication System (PECS; Bondy & Frost, 1994). Because the PECS does not rely on social interest or comprehension of adult prompts, it may be particularly useful for teaching requests to children with ASD. This extremely popular treatment has surprisingly little internally valid evidence of efficacy. Two experimental design studies with children with ASD have demonstrated the short-term efficacy of the PECS on requests (Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Ganz & Simpson, 2004). Unfortunately, neither study provided a strong test of whether the treatment affected generalization of requesting to conditions that were dissimilar to treatment sessions.

There is consensus that the relative efficacy of one treatment over another is likely to vary by pretreatment child characteristics (Lord & McGee, 2001; Lord et al., 2005). In an earlier chapter of Yoder and McDuffie's (2006) study, the authors predicted that the RPMT would be most likely to facilitate generalized initiating joint attention in children with ASD who began treatment with at least some social interest. The rationale for the prediction was that the RPMT models the declarative use of communicative forms that the child already uses to request. We consider the modeling of declarative acts important because Siller and Sigman (2002) have shown a strong longitudinal association between parental modeling of initiating joint attention and later child use of such acts in children with ASD. However, we do not expect the mere modeling of declarative acts to cause generalization from a requesting function to a declarative function unless the child experiences the consequence of declaratives as reinforcing. Children who use relatively more initiating joint attention before treatment are presumed to be motivated by the consequences of declaratives. In contrast, the PECS does not model declarative communication. Therefore, we predicted that the RPMT will be superior to the PECS in facilitating initiating joint attention in children who begin treatment with some initiating joint attention. This type of a priori prediction is an important step toward advancing the empirical basis for differentially treating children with ASD who have different characteristics at study entry.

The purpose of the present study was to determine the relative efficacy of the RPMT and PECS for facilitating the development of turn taking (e.g., object exchange turns), requesting, and initiating joint attention. The following hypotheses were proposed:

Hypothesis 1: The RPMT will be superior to the PECS in facilitating generalized object exchange turn taking.

Hypothesis 2: The PECS will be superior to the RPMT in facilitating requests.

Hypothesis 3: The RPMT will be superior to the PECS in facilitating initiating joint attention, particularly in children with at least some pretreatment initiating joint attention.

Method

Participants

The child participants met the following inclusion criteria: (a) a diagnosis of autistic disorder or pervasive developmental disorder not otherwise specified (PDD-NOS); (b) chronological age between 18 and 60 months; (c) used fewer than 10 words during all of three communication samples (i.e., nonverbal); and (d) passed hearing screenings administered outside of the project. Children were excluded if they demonstrated severe sensory or motor deficits or if English was not the primary language spoken in the home. The parent participants made a verbal commitment to bring the child to a university-based clinic for three 20-min intervention sessions per week for 6 months.

One hundred twenty children were screened for the study criteria between January 2000 and March 2003. The flow of these participants through the study is illustrated in Figure 1. Sixty failed to meet the inclusion criteria. Twenty-one declined to participate because of conflicts in scheduling treatments (5), excessive distance of center from home (10), or other reasons (6). Three children had siblings who also participated in the study. We elected to give these three children the same treatment their sibling had received to prevent treatment contamination. Because they were not randomly assigned to groups, their data were not analyzed. Therefore, our analyses are based on the 36 children who were from different families, were randomized, received treatment, and provided data.

Research diagnoses were based on results from the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000). The ADOS was administered by examiners who had been trained and certified to use Module 1. All 36 children received ADOS scores consistent with a classification of autism. Additionally, all of the children had received prior clinical diagnoses on the autism spectrum: 33 with autism and 3 with PDD-NOS. Table 1 presents descriptive information for the sample. The median formal educational level of the primary parent was 3–4 years of college (range = 10th grade–over 2 years of graduate school). Sixty-nine percent (25) of the children were Caucasian, 22% (8) were African American, and 8% (3) reported "other." Eighty-six percent (31) of the children were boys.

Overview of Design and Procedures

The study design was a randomized group experiment, with pretreatment initiating joint attention measured as a putative predictor of differential response to treatment. Randomization to treatment was accomplished using a computer program and a random number generator and was performed after participants signed consent forms, qualified for the study, and completed Time 1 assessments. This study was conducted in compliance with the Institutional Review Board.

At entry into the study (Time 1), children received four pretreatment assessments: (a) an abridged version of the Early Social Communication Scales (ESCS; Mundy, Hogan, & Doehring, 1996); (b) an unstructured

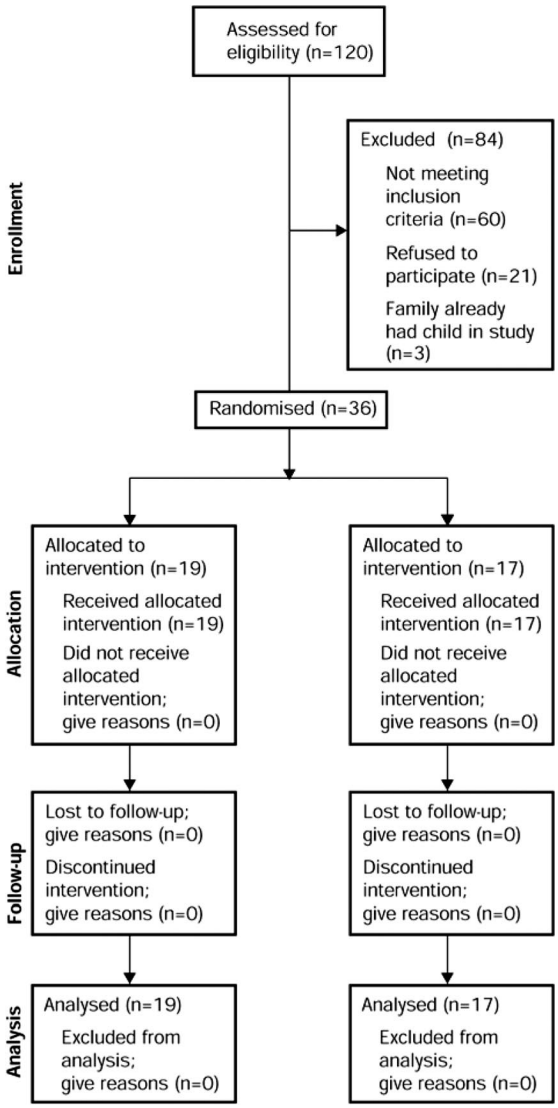

Figure 1. CONSORT flow diagram of the progress through the phases of a randomized trial.

free-play session with an examiner; (c) a measure of turn taking; and (d) a free-play session with their primary caregiver. During the treatment phase (6 months), children attended three 20-min therapy sessions per week. Parents were offered up to 15 hr of training to complement material covered in the children's treatment sessions. During the treatment phase, parents were asked to report their children's attendance to a variety of nonproject therapies and school programs. At the end of the treatment phase (Time 2), the four pretreatment procedures were repeated. All assessment procedures at both time points were conducted by examiners who were not the children's therapists, took place in a university building that was different from the therapy building, and used materials and activities that were not used in therapy sessions. For all assessments except the parent–child free play, children were seated at a table across from the examiner. For all measures except turn taking (for which it would be incompatible), PECS symbols were made available to children at both measurement periods. A small notebook with Velcro strips for PECS symbols (i.e., a communication book) was used, and the PECS symbol for the relevant activity was placed on the communication book after showing the symbol and corresponding object to the child. The examiner responded to all communication acts (including the PECS), regardless of the treatment group to which the child was assigned.

The ESCS-Abridged (Mundy et al., 1996). The ESCS-Abridged is shorter than the more familiar ESCS (Seibert, Hogan, & Mundy, 1982) and consists of a series of activities and adult prompts designed to elicit communication. For the ESCS procedure, the PECS symbol was changed when a new object was presented. In this way, the child never had to discriminate more than one symbol to communicate with the PECS. Frequency of requests and initiating joint attention were coded from this procedure.

Unstructured free play with examiner (UFPE). During this 15-min session, developmentally appropriate objects (i.e., toy baby bottle, baby spoon, doll's hair brush, two teacups, two saucers, teapot, female baby doll, four colored drumsticks, two cubes of foam rubber baby rattle, car, baby's blanket, Fisher-Price Chatter telephone pull-toy) were accessible to the children. The examiner played with the same or similar toy as the child by imitating the child's play. If the child did not attend to any toy for 10 s, then the examiner selected an interesting object and used the object in a play schema that was at or below the cognitive level observed for the child. Examiners verbally commented on the child's or their own actions and vocally imitated the child's discrete vocalizations. Examiners were instructed not to use any type of communication prompt (e.g., no time delays, questions, or gestural prompts were allowed). For the UFPE procedure, one generalized toy symbol was placed on the PECS communication page. The variables of interest from this procedure were the children's frequency of requests and initiating joint attention.

Turn taking. This procedure was adapted from that developed by Ousley (1997) and consists of seven separate activities that were presented with positive affect and a playful demeanor. For each activity, the examiner attracted the child's attention to an object, demonstrated an action, and then gave the object to the child. The goal of the examiner was to get the child to imitate the demonstrated action and give the object back to the examiner. The examiner indicated each turn by saying, "My turn" or "Your turn." If the child failed to imitate or give, then the examiner prompted the desired response using physical prompts for the action or gestural/verbal prompts for gives, as needed. This cycle was repeated up to three times per item. The activities were squeezing a squeak toy, putting on sunglasses, playing peek-a-boo, putting a puppet on one's hand, banging blocks, beating a drum, and putting a ball into a small basketball goal. The variable of interest from this procedure was the children's frequency of object exchange turns (i.e., unprompted giving of object to the examiner; Eckerman & Didow, 1989; Ross & Lollis, 1987).

Parent–child free play. This 20-min procedure was used to assess parental strategies for encouraging sustained attention with and communication about objects. Parents were allowed to select five toys from a large set and were given the following instructions: "We are interested in what it is like when you try to join your child in doing the things that he or she likes. We are also interested in how he or she will communicate with you during this time." After the first 10 min, parents were allowed to change toys, if desired. Parent behaviors were coded from this procedure (see Table 2). Variables used for analysis were the proportion of codable intervals in which particular parental behaviors were used.

Treatments

Of the participants, 19 children were assigned to the PECS and 17 to the RPMT. All treatment sessions took place in a university clinic. The two treatments were designed to be as similar as possible on several dimensions. Both treatments included both child and parent components. Both were conducted by master's-level professionals or closely supervised bachelor of arts-level paraprofessionals. The professional leading the RPMT team held a master's degree in early childhood special education, and the

Table 1
Means and Standard Deviations for Descriptive Variables at Time 1

Variable	PECS (n = 19)			RPMT (n = 16)		
	M	*SD*	Range	*M*	*SD*	Range
Chronological age (yrs.)	3.1	0.8	7.8–4.5	2.7	0.5	1.9–3.5
Nonverbal mental age (mos.)[a]	18.8	4.5	11.5–26.5	18.6	3.2	13–23.5
Verbal mental age (mos.)[a]	11.7	3.4	7–19	11.9	2.5	7–19
IQ[a,b]	55	7	49–67	54	6	49–67
Number of words used across ESCS and UFPE	0.6	1	0–5	0.4	0.7	0–2
Number of spoken acts across ESCS and UFPE	1.1	2	0–6	0.6	1	0–4
Number of initiating joint attn. in ESCS	3	4	0–18	2	2	0–7
Number of requests in ESCS	13	8	1–26	11	6	2–20
Number of object exchanges in turn-taking proc.	5	5	0–16	2	3	0–8
Parent report of words understood[c]	108	87	3–291	62	49	1–141
Parental occupational status[d]	43	22	10–87	51	21	18–80

Note. PECS = Picture Exchange Communication System; RPMT = Responsive Education and Prelinguistic Milieu Training; yrs. = years; mos. = months; ESCS = Early Social Communication Scales; UFPE = unstructured free play with examiner; attn. = attention; proc. = procedure.
[a] Based on the Mullen Scales of Early Learning (Mullen, 1992). [b] Reported for children with standard scores over the possible minimum (i.e., 49) (n = 16 for PECS; n = 11 for RPMT). [c] MacArthur Communication Development Inventory (Fenson et al., 1993). [d] Based on the International Standard Classification of Occupations (Stevens & Cho, 1986). Population median was 29 (*SD* = 23).

professional leading the the PECS team held a master's degree in speech-language pathology. In both treatments, children were offered three 20-min individual therapy sessions per week for 6 months (i.e., 72 sessions). Parent components of the treatment models were implemented by the same master's-level professionals as those providing the child's treatment. Parents observed the child sessions for both treatments.

The PECS. The PECS was developed by Bondy and Frost (1994) for children with ASD who have limited communication skills. It consists of six phases, beginning with the physically prompted exchange of a single picture without distractor pictures and ending with the exchange of a sentence strip in response to, "What do you see?" Full details of the treatment are available in the training manual (Bondy & Frost, 1994). If children mastered the phase six training objectives, then they were taught to use locative and adjective PECS symbols to request (e.g., "I want the *big* ball"). Additionally, such high-functioning children were taught to use the PECS to give directions, ask for nonpreferred items, and differentiate yes–no requests from yes–no labels (i.e., "Do you want this?" vs. "Is this a frog?"). The two project members who comprised the PECS team participated in a 2-day workshop provided by two certified PECS therapists. The implementation plan was to use the clinic room as the "lead environment" and to teach the parent to support PECS use in the home, community, and school. All aspects of the PECS curriculum were followed within the constraints of this model, including the use of a second adult to physically prompt the child from behind during the initial instructional phases and transitions between phases. The two adults exchanged roles once the child became fluent in the skill being taught in a particular treatment phase to increase the probability of across-person generalization. The parent component of the PECS treatment involved meeting at the parents' convenience, which most frequently occurred immediately after the child's treatment session. The primary content of the parent component was to demonstrate and discuss ways for promoting PECS use outside of the therapy room. PECS materials were provided for use at home and in the community.

The RPMT. The RPMT was designed to facilitate intentional communication for the three primary pragmatic functions during the prelinguistic period in young children with developmental delays (Yoder & Warren, 2002). A primary therapist worked with the child 2 days a week, while a secondary therapist worked with the child 1 day a week to increase the probability of across-person generalization. A 1:1 teaching format was used in RPMT sessions. During each session, the therapist first attempted to establish one or more play routines (i.e., turn-taking sequences around an object or activity) that was enjoyable and motivating to the child. When the child was highly motivated to communicate, the therapist used the least intrusive, but effective, communication prompts (e.g., saying, "Look at me"; moving her head to intersect the child's gaze) to elicit requests for objects or actions. RPMT therapists attempted to stimulate initiating joint attention through modeling the use of recently learned communicative behaviors. For example, if the child recently learned to point to request, then the RPMT therapist would model the use of pointing to show the child an event that was thought to be interesting to the child (e.g., pointing to a just-fallen block tower and looking at the child). Additional description of the RPMT can be found in Yoder and Warren (1998). When children used at least one unprompted request and at least one unprompted initiating joint attention act per minute in treatment sessions, Milieu Language Teaching (Warren, 1991) was used to facilitate linguistic communication. Milieu Language Teaching is similar to the RPMT except that it focuses on spoken language, rather than prelinguistic, goals.[1] The purpose of the parent component was to support parents in using responsive strategies to help their children engage in productive play with objects in a playful manner and to facilitate their children's communication and language development. The Hanen Centre curriculum was followed for this component of the treatment (Sussman, 2001).

Fidelity and Description of Treatment Implementation

Once per month, each therapist–child session was coded for fidelity of treatment.[2] For the RPMT, a rating scale was used in which the following components were rated on a 3-point scale (1 = poor, 2 = good, 3 = excellent): therapist's responsivity, relationship building, routine building, and use of appropriate prompting and consequence strategies. For the PECS, a separate rating scale was used to measure the presence and quality of each treatment technique for each PECS phase. Interobserver agreement

[1] Treatment manuals are available from Paul Yoder upon request.

[2] The Fidelity of Treatment Rating Scale is available from Paul Yoder upon request.

Table 2
Definitions and Examples of Variables Coded During ESCS, UFPE, and Parent–Child Free-Play Session

Code	Definition	Example
	Child variable	
Intentional communication	Gesture or nonword vocalization combined with coordinated attention to object or person; conventional gesture; spoken word use	Reaching to object while looking at adult; pointing to "Jack" coming out of his box; saying "Bubbles" after adult blows bubbles.
Requesting	Intentional communication act that directs another to (a) give a desired object; (b) carry out an action (not for information); (c) continue carrying out a gamelike social interaction or routine; (d) do something; or (e) give comfort.	Reaching to object; looking to adult to get adult to retrieve object.
Initiating joint attention	Intentional communication act about an object that attempts to get the adult to comment, laugh, smile, show attention, or give a label.	Clapping at fallen block tower and looking to adult.
Other function	Intentional communication act that did not fit the "requesting" or "initiating joint attention" definitions.	Waving to an adult examiner as they entered the room.
Object exchange turns	Voluntary extension of a hand that is holding an object toward the adult; must be extended at least half the distance between the child and adult.	Giving bean bag back to adult, after adult demonstrates putting bean bag through basketball hoop and hands bean bag to child.
Productive engagement	Noncompulsive touching or visual attention to object or adult for at least 5 consecutive seconds.	Moving a car with his/her hands; playing peek-a-boo with adult by using hands to hide his/her eyes.
Vocalization	Any discrete phonation (duration of less than 2 s) in which there is voicing other than cries.	Saying, "Ah."
	Parent variable	
Strategies to maintain engagement	Adult (a) imitates the child's action; (b) takes a brief developmentally appropriate turn; (c) sabotages environment to prompt communication; (d) hands child materials needed for child to complete his or her turn; (e) inserts turn during vocal play or social game; (f) follows child's play or attentional lead; (g) manages materials when they are distracting; (h) demonstrates a new play action within child's play level with object of child's current attention; (i) briefly helps child succeed in self-initiated action.	Gently removing rattle from child's hand, briefly shaking it, and giving it back to the child.
Active engagement with child	Adult moves an object, touches child, or moves self in social game in a manner that is deliberate; requires more than talking to or observing the child.	Putting a blanket on the baby doll.
Use of developmentally appropriate play	Adult displays positive or neutral affect, uses action that is reciprocal with child's action, and engages in one of the following: (a) plays at or below the child's cognitive play level; or (b) if play is initially above child's cognitive play level, then drops back to lower level immediately when child does not engage.	Putting a bottle to doll's mouth after child seems to become tired of feeding doll.
Optimal response to child communication or vocalization	Adult puts the presumed meaning of the child's nonverbal communication into words, complies with the child's request, or imitates the child's nonverbal communication.	Saying, "Car. I'll wind it up," and winding up toy car after child hands it to adult; imitating child's "Ahhh."

Note. ESCS = Early Social Communication Scales; UFPE = unstructured free play with examiner.

for independent ratings was calculated for 20% of the data, resulting in a mean interobserver agreement of .99 (*SD* = .006) for the RPMT and .90 (*SD* = .1) for the PECS.

Nonproject Treatment Description

Because parents were free to seek treatment outside of the project treatments, they were asked each month to estimate the number of hours that their children received specific types of therapy and methods for that month. The variables used for analysis were (a) the average number of hours in speech/language therapy per month and (b) the average number of hours per month in any therapy (including speech/language and applied behavior analysis therapy).

Coding and Reliability of Coded Variables

Initiating joint attention, requests, object exchange turns, and various aspects of parent–child interaction were coded from videotaped records of the sessions with the aid of custom-made software: Transcript Builder (Tapp & Yoder, 2001a), PROCODER (Tapp & Walden, 1993), and Turntaker (Tapp & Yoder, 2001b). Definitions and examples of codes are presented in Table 2. Interobserver reliability was estimated on independently coded and randomly selected samples of at least 20% of the coded data from all procedures at both time periods. The average intraclass correlation coefficient (ICC) was .85 (*SD* = .13) and .95 (*SD* = .03) at Time 1 and 2, respectively. All Time 2 variables had ICCs above .90. All coded variables had ICCs above .70.

Examination of the Effect of Blindness-to-Treatment Assignment on Potential Coding Bias

To determine whether blindness to treatment assignment affected the coding and thus the results of the test of the research questions, we hired a staff member who was not involved with assessment of the 36 children and was blind to their treatment assignment. After receiving coding training on children at Time 1, she independently coded all of the ESCS sessions at Time 2.

Results

Preliminary Analyses

Examination of whether duration of session covaried positively with frequency. Frequencies of variables obtained from the ESCS and UFPE were not significantly correlated with durations of the sessions for Time 1 or Time 2. Therefore, frequency was the metric selected for the Time 1 and Time 2 measures of these variables (Cohen & Cohen, 1984).

Treatment description and fidelity. The number of therapy sessions children attended averaged 60 (SD = 7.1, range = 33–70). Attendance to sessions was not significantly related to amount of change or individual differences in Time 2 outcomes and did not statistically interact with treatment group to predict any outcome. There were no significant group differences in the number of people using the therapeutic techniques outside of therapy sessions, as reported by the parents (M = 2.6, SD = 1.2 in each group). Fidelity of treatment in the child therapy sessions was near the scale maximum (M = 2.99, SD = .017; M = 2.88, SD = .09 for the RPMT and PECS sessions, respectively).

Examination of whether blindness-to-treatment assignment affected coding. Scores from a coder who was blind to treatment assignment correlated highly with those of a coder who was not blind to treatment assignment on requests (ICC = .87) and initiating joint attention (ICC = .91). The statistical interactions between blindness status and treatment group predicting Time 2 requests and initiating joint attention were nonsignificant (ps > .60) and extremely small (d = .015 and .012 for requests and initiating joint attention, respectively).

Examination of pretreatment group differences and whether a covariate was needed. Fifty-eight pretreatment variables and two nonproject treatment attendance variables were tested for group differences. Examples of variables included were severity of autism, cognitive impairment and level, language level and impairment, communication level, motor imitation level, play level, demographic variables (e.g., age, gender, socioeconomic status), and parental responsivity. Only two variables were (a) different between treatment groups prior to treatment onset, (b) covaried with Time 2 outcomes, and (c) did not violate the assumption of homogeneity of slopes. The first of these was Time 1 ADOS algorithm score, $t(34) = -2.4$, $p = .02$, which correlated negatively with Time 2 frequency of requests in the ESCS ($r = -.35$, $p = .04$) and Time 2 frequency of initiating joint attention in the UFPE ($r = -.40$, $p = .007$). The second was Time 1 object exchange turns, $t(34) = 2.7$, $p = .01$, which correlated positively with Time 2 frequency of object exchange turns ($r = .65$, $p < .001$). In analyses involving treatment groups, the appropriate Time 1 variable was statistically controlled.

Treatment effect on parent variables. Parents in the RPMT group (M = 10.6, SD = 2.2) chose to receive more hours of training than did parents in the PECS group (M = 7.9, SD = 2.3), $t(34) = 3.59$, $p < .01$, $d = 1.2$. However, the amount of parent training was not associated with any Time 2 parent responsivity and did not interact with group to predict the Time 2 parent variables. RPMT parents (M = .85, SD = .09) showed proportionally more intervals in which they used at least one adaptive strategy to maintain the child's focus of attention at Time 2 compared with PECS parents (M = .75, SD = .12), $t(34) = 2.6$, $p = .015$, $d = .75$, 95% CI = .88–4.94.

Growth in frequency of intentional communication for three major pragmatic functions. Table 3 presents the descriptive statistics and the effect size of Time on the dependent variables for this study. There was an increase in (a) the number of object exchange turns, $F(1, 35) = 7.8$, $p = .008$; (b) the number of initiating joint attention acts in the ESCS, $F(1, 35) = 7.4$, $p = .01$, and UFPE, $F(1, 35) = 11.3$, $p = .002$; and (c) the number of requests, $F(1, 35) = 11.1$, $p = .002$ in the ESCS. However, there was no significant change in requests in the UFPE. Therefore, we did not test putative treatment effects on requests in the UFPE.

Hypotheses 1 and 2: Main Effects of Treatment on Object Exchange Turns and Requesting

We expected the RPMT to increase object exchange turns more than the PECS and for the PECS to increase requests more than the RPMT. Our prediction was confirmed for Time 2 object exchange turns, controlling for Time 1 object exchange turns, $t(34) = 2.46$, $p = .019$, $d = .97$; 95% CI = .22–4.29. The adjusted means were 7.1 (SE = .86) and 4.0 (SE = .81) for the RPMT and PECS, respectively. Using the Time 1 average across groups (3) and these adjusted means, we can estimate the average growth in each group

Table 3
Change in Frequency of Intentional Communication Acts by Pragmatic Function

Variable	Time 1		Time 2		
	M	*SD*	*M*	*SD*	η^2: Time effect
Frequency of requesting in ESCS	11.9	7.3	17.7	10.7	.25
Frequency of requesting in UFPE	4.2	9.2	4.5	5.7	.001
Frequency of initiating joint attention in ESCS	2.7	3.5	4.7	4.8	.18
Frequency of initiating joint attention in UFPE	2.7	4.5	8	9	.24
Frequency of object exchange turns	3.7	4.5	5.5	4.7	.18

Note. ESCS = Early Social Communication Scales; UFPE = unstructured free play with examiner.

after adjusting for initial group differences (approximately four in the RPMT and one in the PECS). The PECS did not have a main effect on requests.

Hypothesis 3: Treatment Effects on Initiating Joint Attention as a Function of Pretreatment Initiating Joint Attention

We expected a statistical interaction between pretreatment initiating joint attention and group predicting Time 2 initiating joint attention. To test this conditional treatment effect, we used the multiple regression procedures outlined in Aiken and West (1991). All assumptions of regression were tested, and only those results that met the assumptions were reported. To reduce the number of analyses and improve efficiency of presenting the results, we summed the number of initiating joint attention acts across procedures within both measurement periods. The scores were highly correlated between procedures at Time 2 ($r = .65$, $p < .001$). However, the pattern of results is the same when analyses are conducted on the individual measures of initiating joint attention.

Pretreatment initiating joint attention predicted differential treatment effects on Time 2 initiating joint attention ($\Delta R^2 = .36$, 95% CI = .12–.94), $t(33) = 4.4$, $p < .001$. Children who used at least seven initiating joint attention acts across both Time 1 procedures benefited more from the RPMT than the PECS. At the point at which the RPMT is superior, the unadjusted predicted number of initiating joint attention acts at Time 2 are 21.5 and 13.5 for the RPMT and PECS, respectively. Therefore, for the children most affected by the RPMT, gains of at least 14.5 and 6.5 acts were made by children in the RPMT and PECS, respectively. Surprisingly, children who used, at most, one initiating joint attention act across both procedures before treatment benefited more from the PECS than from the RPMT. At the point at which the PECS is superior, the unadjusted predicted number of initiating joint attention values at Time 2 is 13.5 for the PECS and 5.6 for the RPMT. For children most affected by the PECS, gains of at least 12.5 and 4.6 acts were made by children in the PECS and RPMT, respectively. This interaction is illustrated in Figure 2.

Exploratory Analysis

As an exploratory analysis, we examined whether pretreatment initiating joint attention summed across the ESCS and UFPE predicted differential response to treatments on Time 2 requests in the one context in which growth was seen: the ESCS. This interaction was significant, $t(33) = 3.25$, $p = .003$, and produced a strong effect size ($\Delta R^2 = .24$, 95% CI = .03–.80). Children using more than 10 initiating joint attention acts across procedures at Time 1 benefited more from the RPMT, and children using fewer than two initiating joint attention acts across procedures benefited more from the PECS. At the point at which the PECS is superior, the unadjusted predicted number of requests in the ESCS at Time 2 is 21 for the PECS and 14 for the RPMT. At the point at which the RPMT is superior, the unadjusted predicted number of requests in the ESCS at Time 2 is 30 for the RPMT and 19 for the PECS.

Discussion

This study was conducted to test the relative efficacy of the PECS versus the RPMT on initiating joint attention, object exchange turns, and requests. There was also a prediction that children with at least some pretreatment initiating joint attention would acquire more initiating joint attention in the RPMT than in the PECS. There was a prediction of a main effect favoring the RPMT for object exchange turns and one favoring the PECS for requests.

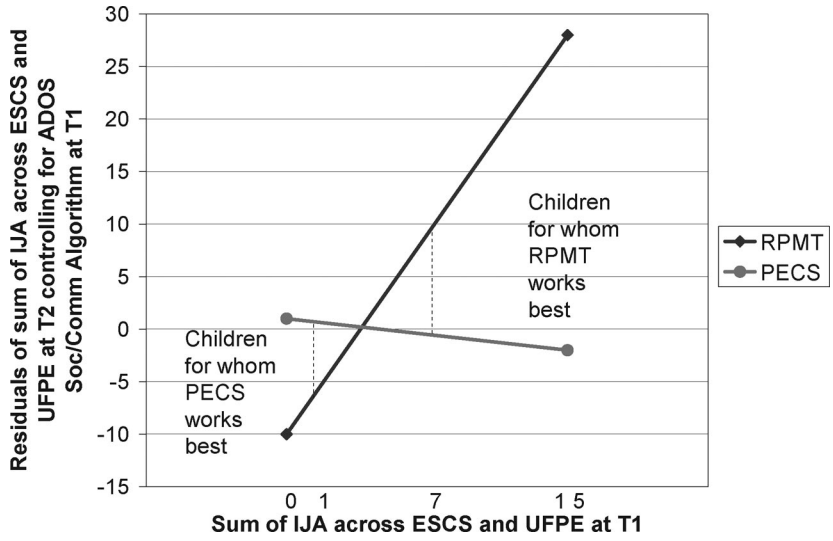

Figure 2. Statistical interaction of Time 1 (TI) Initiating Joint Attention × Group predicting the residuals of Time 2 (T2) number of initiating joint attention acts (controlling for Time 1 Autism Diagnostic Observation Schedule [ADOS]). RPMT = Responsive Education and Prelinguistic Milieu Teaching; PECS = Picture Exchange Communication System; IJA = initiating joint attention; ESCS = Early Social Communication Scales; UFPE = unstructured free play with examiner; Soc/Comm = social/communication.

Although children's initiating joint attention grew in both treatments, the RPMT was superior to the PECS in facilitating initiating joint attention in children using at least seven initiating joint attention acts across the two communication procedures assessing this skill before treatment began. This effect size was quite large (Cohen, 1988). This is arguably the most important finding of the present study. It is possible that adult modeling initiating joint attention and increasing the reinforcing value of social interaction through increasing the success of communication during the RPMT treatment facilitated initiating joint attention growth. This finding is important because it adds evidence to the literature that initiating joint attention is malleable in children with ASD. There is some evidence that other treatments containing elements of incidental teaching and discrete trial training facilitate generalized initiating joint attention in children with ASD (Kasari et al., 2000; Whalen & Schreibman, 2003); however, these studies did not provide strong evidence that treatment caused initiating joint attention to generalize to other locations, people, materials, and activities.

The present study adds to this literature in four ways. First, the present results provide information about the characteristics of children that are most appropriate for the RPMT when initiating joint attention is the goal. Second, the effect size for this interaction is quite large, suggesting that relatively low-intensity treatments can lead to important gains. Third, the effect of the RPMT across two procedures assessing initiating joint attention reduces the possibility that effects are because of specifics of the measurement context. Finally, it is important that the conditional effects favoring the RPMT on initiating joint attention were predicted a priori on the basis of theory. Such results constitute a better basis for expecting replication than do exploratory findings.

In contrast, the surprising conditional effect of the PECS on initiating joint attention in children with little initial initiating joint attention may be less likely to replicate than the the RPMT effect on initiating joint attention in children with some initial initiating joint attention. If replicated, then the effect of the PECS on initiating joint attention may be the result of such children acquiring the prerequisite skill of coordinated attention to object and person through PECS use and learning that people can be rewarding through successful intentional communication. Although not measured in the present study, perhaps mothers naturally model initiating joint attention acts.

The predicted main effect on object exchange turns was confirmed, and the treatment effect size was large (Cohen, 1988). To our knowledge, this is the first demonstration that behavioral treatment can affect generalized object exchange turns in prelinguistic children with ASD. It was expected that the RPMT would be superior to the PECS in teaching this skill because object exchange is a primary behavior that is taught in RPMT, and this form is not directly taught in PECS. Additionally, object exchange turns were assessed in the context of a series of turn-taking activities. Object exchange is taught using the RPMT in the context of various turn-taking routines. The predicted main effect favoring the PECS on requests was not confirmed. Instead, the predicted effect occurred only in children with fewer than two pretreatment initiating joint attention acts across the two communication procedures that assessed initiating joint attention. This effect was large (Cohen, 1988). It is not surprising that the PECS has a superior effect to the RPMT in children with initially low rates of initiating joint attention. The PECS does not require that children initially attend to or understand adults to benefit from the physical prompting that the "facilitator" behind the child provides. RPMT therapists almost never use physical prompting and never use a second adult to physically prompt from behind. Although many studies have shown that behavioral treatments affect generalized requests in children with ASD (Hwang & Hughes, 2000), this is the first to demonstrate differential superiority of one treatment over another in facilitating requests in children with ASD with low initial initiating joint attention. It should be noted that the effects on requests favoring the PECS were measured in the most structured measurement context: the ESCS. This is interesting, in part, because the PECS is the more structured of the two treatments. Perhaps the similarity between treatment procedure and measurement context maximized our ability to detect differential treatment effects on requests.

It was surprising that the RPMT was superior to the PECS in promoting requesting for children who initially used at least 10 initiating joint attention acts across the two communication procedures. This may have occurred because children with more social interest may better understand the RPMT prompts. If children can understand the RPMT prompts, then the RPMT may be more beneficial than the PECS because the former treatment teaches request forms that are not restricted to referents that happen to be depicted on the child's communication board.

Some readers may be needlessly concerned about interpreting statistical interactions in which a small number of participants fall into the regions of significance. For example, there are 11 children who scored in the lower region of significance, and 10 children who scored in the upper region of significance in the interaction depicted in Figure 2. It should be noted that the interactions are modeled on the entire sample, not just those participants in the regions of significance. No undue influence for any participant was found for any reported analysis.

One of the weaknesses of the study is that the examiners conducting the pre- and postassessments were also the primary data coders and could not be kept blind to the children's treatment assignment. However, we consider it unlikely that the nonblind status of examiners and coders accounted for the results for three reasons. First, they did not know the hypotheses of the study, and the complexity of the results is unlikely because of systematic bias on the part of examiners. Second, it is unlikely that the nonblind status of the examiner/coders affected the results because of the high interobserver reliability for the variables. Third, our analysis indicated no evidence that blindness status of coders had an effect on the results.

The present study has many strengths. Random assignment was used to assign children to treatments. Treatment groups were equivalent on 56 pretreatment variables and two nonproject treatment attendance variables. The two variables that could have posed a threat to internal validity were statistically controlled. Even the 2 children who received only 47% and 57%, respectively, of available sessions were included in the analysis, thus we met the "once randomized, always analyzed" rule of thumb. There was a very high level of treatment fidelity in both treatments. The pretreatment variable predicting response to treatment was predicted before conducting the study. Finally, the outcomes were ecologically valid measures of communication assessed within contexts

that required generalization across locations, persons, materials, activities, and interaction styles.

It is useful to note that the children experienced a maximum of 1 hr of staff-implemented treatment per week for 6 months. Parents received an average of 9.25 hr of staff contact during the 6 months. Although we do not know the extent to which parents used the therapeutic methods at home, the two treatments tested in the present study required a small percentage of the 25 hr of treatment per week recommended for children with ASD (Lord & McGee, 2001). It should be noted that insurance companies do not universally provide coverage of communication treatment for children with ASD. It is hoped that this report will provide the needed evidence to motivate more insurance coverage for treatments, such as the RPMT and PECS, when provided to appropriate children and with appropriate goals.

In summary, this internally valid comparison of two low-intensity prelinguistic treatments showed that the RPMT facilitated object exchange turns and initiating joint attention more than did the PECS. The latter result occurred only for children who began treatment with at least some initiating joint attention. In contrast, the PECS facilitated requests more than the RPMT in children with very little initiating joint attention prior to treatment. The effect sizes were large for initiating joint attention and requests and moderately large for object exchange turns. These ecologically valid outcome variables were measured in strong generalization contexts and provide an important step toward matching the child and goal to the treatment.

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