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Research Article

Picture Exchange Communication System and Pals: A Peer-Mediated Augmentative and Alternative Communication Intervention for Minimally Verbal Preschoolers With Autism

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Purpose: This study was conducted to investigate the effectiveness of a social intervention that integrates peer-mediated approaches and the Picture Exchange Communication System (PECS).
Method: Effects were evaluated using a series of A-B designs replicated across 4 children with severe autism and limited verbal skills. Seven peers without disabilities were trained to use PECS and facilitative social skills. Measures of changes included rates of communication behaviors, modes, functions, and engagement.
Results: Outcomes revealed an intervention effect for 1 child with autism, and this effect was replicated across 3 other children. All children improved in peer-directed communication, with greater increases for 2 children during snack time. For each child with autism, the primary communication behavior was to initiate with picture symbols to request; the peer's primary communication was to respond. Two children increased communicative functions to comment and to share, and all 4 children showed improved social engagement. All peers increased their communication with the children with autism.
Conclusions: These findings add to the limited research on the benefits of teaching typically developing peers to be responsive listeners to preschoolers with autism by learning to use PECS. These results invite further investigation of teaching peers other augmentative and alternative communication approaches and how to increase children's communication with peers for different purposes.

Over the past few decades, investigations of augmentative and alternative communication (AAC) interventions for young children with complex communication needs have revealed positive gains in requesting behaviors, vocalizations, vocabulary, and, for some, spoken communication (Bock, Stoner, Beck, Hanley, & Prochnow, 2005; Flippin, Reszka, & Watson, 2010; Ganz, Simpson, & Corbin-Newsome, 2008). Recent reviews have documented the effectiveness of one type of AAC system, the Picture Exchange Communication System (PECS; Bondy & Frost, 1994), for individuals with autism spectrum disorders (ASD) (Flippin et al., 2010), with the most positive outcomes evident for preschool age children (Ganz, Davis, Lund, Goodwyn, & Simpson, 2012). PECS is considered a promising communication intervention for children with ASD based on recent evaluations of studies conducted by the National Autism Center (2015).

PECS Instruction for Children With Autism

PECS was originally developed for nonverbal children with ASD to teach spontaneous, functional communication via symbols or pictures (Bondy & Frost, 1994). It is a low-tech system consisting of pictures that are exchanged with a communication partner. The PECS training protocol consists of six phases. In Phase I: The Physical Exchange, the child exchanges a picture to request a desired item, and physical prompts are used to guide an exchange with an

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adult. In Phase II: Expanding Spontaneity, the variety of communication partners and the distance the child must travel to request a preferred item increase (i.e., programmed generalization). In Phase III: Picture Discrimination, the child selects preferred and nonpreferred items from an array of symbols. In Phase IV: Sentence Building, the child selects present and nonpresent items by selecting multiple symbols together on a sentence strip (e.g., "I want + object"). In Phase V: Responding to "What Do You Want?" the child responds to an adult's question by selecting the appropriate symbol. Phase VI: Responsive and Spontaneous Comments is focused on vocabulary expansion and responding to adult questions (e.g., "What do you see?" and "What do you have?"). Reported advantages of PECS are few prerequisite skills (e.g., eye contact, oral motor skills) are required, it is inexpensive and the pictures are easy to create, and strategies to teach generalization of behaviors are programmed into the intervention (Bondy & Frost 1998; Ganz et al., 2008; Garfinkle & Schwartz, 2002).

Reviews by Flippin et al. (2010) and Ganz et al. (2012) have assisted in establishing the validity of clinical claims of the effectiveness of this popular and widely adopted intervention for young children with ASD. Flippin et al. (2010) provided a thorough evaluation of evidence for the effectiveness of PECS for increasing communication and speech outcomes for children (less than 18 years old) with ASD. Their meta-analyses of 11 studies included both single-participant and group research. Overall, the quality of evidence for PECS was considered to be adequate; the authors reported that PECS treatment had a significant impact on communication outcomes and more limited effects on maintenance and generalization of gains. Ganz et al. (2012) conducted a meta-analyses using what they reported as a more advanced metric (the improvement rate difference) to summarize and calculate effect sizes within 13 PECS intervention studies. Results supported the notion that PECS can improve functional communication such as initiating requests, and this finding was consistent across participant ages and disability types (i.e., children with autism alone or autism and intellectual disability).

Empirical support for the use of PECS with preschool children with autism comes from both single-participant and group research studies. Ganz et al. (2008) taught three preschool children with autism the first four phases of PECS during interactions with researchers. Two of these children learned to use PECS as a communication system to make requests for preferred items; however, PECS was not an effective intervention for one child. One young girl made no requests using pictures over 31 sessions; thus, data collection was discontinued. The authors acknowledged the limitations that requesting increased for only two of the three children and that communication was assessed only during sessions with research staff not during sessions with other communication partners. Yoder and Stone (2006a, 2006b) conducted a randomized group experiment comparing the efficacy of PECS to that of responsive education and prelinguistic milieu teaching (RPMT) for 36 children with autism that were 18 and 60 months of age. Communication partners during treatment were the researchers. A main effect of time was found for several aspects of communication, including initiating joint attention (JA), exchanging objects in turn-taking activities, and making requests (Yoder & Stone, 2006a). The treatment effects of PECS versus RPMT differed, depending on the outcome variable. PECS had a positive main effect on spoken communication, with the children in the PECS group producing more nonimitative communication acts and more different nonimitative words in communication at posttest than the children in the RPMT group (Yoder & Stone, 2006b). RPMT had a positive main effect on object exchange (Yoder & Stone, 2006a). The effects of treatment on initiating JA was moderated by the children's initial JA skills; children who had higher levels of JA at pretest benefitted more from RPMT, whereas those with low levels or no JA at pretest benefitted more from PECS (Yoder & Stone, 2006a). Another randomized trial was conducted to compare the effects of pivotal response training (a verbal intervention) with those of PECS on spoken language of preschool children with autism (Schreibman & Stahmer, 2014). Parents participated as communication partners in both groups. Results revealed that children in both interventions made similar gains in spoken communication; no significant differences were found between the two conditions. Children gained approximately 80 spoken words over the course of 6 months while in the study.

PECS intervention research to date has rarely included outcomes within child-centered play contexts with same-age peers or with listeners other than adults (Carr & Felce, 2007; Howlin, Gordon, Pasco, Wade, & Charman, 2007; Yoder & Stone, 2006a, 2006b). One of the few studies to document positive outcomes following PECS intervention on communication of preschool children with autism and other developmental disabilities (DDs) in an integrated, play-based classroom was completed by Schwartz, Garfinkle, and Bauer (1998). During a 15-month intervention, 31 preschool children improved from limited or no functional communication to using PECS sentence strips (e.g., "I want ___") to communicate with peers without DDs. Although not specific to children with autism, this study was the first to report measures focusing on communication outcomes with peer partners versus adult listeners. The authors acknowledged that the outcomes were not based on random assignment or comparison with a group that did not receive PECS intervention, and specific peer teaching steps and peer communication behaviors were not reported.

Peer-Mediated Social Interventions

Peer-mediated interventions have much empirical support for improving cardinal deficits related to autism (e.g., social communication, reciprocity, restricted play; Chan et al., 2009; Reichow & Volkmar, 2010). These interventions consist of teaching a small group of socially competent peers specific strategies to initiate and maintain social interactions and communicative exchanges with classmates with autism (Goldstein, Schneider, & Thiemann, 2007). Training peers without disabilities to be responsive

communication partners leads to many social gains for children with autism, including improved play and functional communication skills (e.g., mutual attention, requests, comments; Garfinkle & Schwartz, 2002; Thiemann & Goldstein, 2001, 2004).

Consistent improvements in social interactions between preschool children with and without moderate DDs have been found following a relatively short period of peer "buddy" skills training (English, Goldstein, Shafer, & Kaczmarek, 1997; English, Shafer, Goldstein, & Kaczmarek, 1997; Goldstein, English, Shafer, & Kaczmarek, 1997). Goldstein et al. (1997) successfully trained two groups of four preschool children without DDs (n = 8 children) during three direct instruction sessions to be "good buddies" to four classmates with DDs. The children were taught to maintain proximity, establish mutual attention, and suggest playing together and to continue playing and talking while staying close together across the preschool day. The authors simplified the instructions to Stay-Play-Talk (English, Goldstein et al. 1997; English, Shafer et al. 1997; Goldstein et al. 1997) and taught peers the strategies using a standard protocol of modeling, guided practice, and corrective feedback. Following buddy skills training, results revealed improved social communicative interactions for both cohorts of trained peers and all eight children with DDs. The authors asserted that the ease of implementing the intervention with typically developing children was due to the nature of the strategies; the focus was on commenting and responding, which fit more naturally into typical patterns of interactions. In the current study, we examined a modified version of Stay-Play-Talk by teaching peers how to comment and respond using PECS in the *talk* phase.

Combining PECS and Peer-Mediated Interventions

Light (1989) defined communication competence as an individual's ability to functionally communicate in natural environments to meet daily needs. Thus, for young children with autism learning to use PECS in inclusive preschools, functional communication would imply the ability to exchange pictures to communicate for a variety of reasons with both adult and peer communication partners. Supporting peers to be more effective "listeners" to children learning PECS or any other type of AAC system may lead to more successful exchanges and thus motivation to engage in reciprocal social interactions. Although limited, preliminary evidence on teaching children with autism to communicate using PECS with peers is encouraging (Schwartz et al., 1998). There are many potential advantages to training peers as effective AAC users and listeners. Opportunities for successful communication and play exchanges with same-age peers are necessary for young children with autism to learn early social skills, and successful social interactions will depend on the ability of both communication partners to send and receive messages effectively (Kent-Walsh & McNaughton, 2005). Peers can be taught to model AAC use in the form of augmented input or to initiate with picture symbols and to respond by giving or sharing objects. Peers also can be taught to provide natural social reinforcement and feedback on the accuracy of responses during typical play routines. Participation in successful interactions with peers may lead to a stronger desire for children with autism to observe and imitate their peers—precursors to learning essential social language skills (Garfinkle & Schwartz, 2002).

The purpose of this study was to examine the effects of a PECS intervention combined with peer-mediated instruction to increase communication between children with autism and typically developing preschool children in routine social activities. The specific question was "Does teaching peers to be responsive communication partners using PECS affect rates of functional communication of nonverbal or minimally verbal preschoolers with autism?" We also assessed the collateral effects of the intervention on time engaged in dyadic play.

Method

Participants

Four preschool children with ASD and seven peers without disabilities participated in the study. The children with autism ranged in age from 3;0 (years; months) to 5;1 and included three boys and one girl. They attended a center-based program for young children with autism that provided integrated treatment approaches such as applied behavior analysis, PECS, and TEACCH (treatment and education of autistic and communication related handicapped children) principles within a developmental framework. All children met the following criteria: (a) diagnosis of autism by a developmental pediatrician, (b) nonverbal or minimally verbal (20 words or less), (c) exchanging pictures to make requests at a minimum of PECS Phase I, and (d) limited peer social interaction skills based on teacher report using a 15-item Social Impression Rating Scale (SIRS; adapted from Odom et al., 1997). The SIRS (with scores of 1 through 5, with 1 = *never* and 5 = *always*) was completed by the primary teacher or therapist responsible for leading the educational team for that child. Before the study, all children had been using PECS to communicate with varying degrees of complexity for approximately 6 months to 1 year with an adult partner. Demographic information on the children with autism is provided in Table 1.

Wade, age 5;1, had been attending the center for 2 years at 5 days/week and 7 hr/day. He had an expressive vocabulary of fewer than 10 words that he used to request preferred items, used limited gestures (e.g., pulled adults or used adult's hand), and was communicating at Phase IV of PECS. Every day, Wade received 30 min each of speech-language therapy, occupational therapy, and behavioral services as part of his early intervention program. Teacher ratings on the SIRS revealed limited peer interaction skills, with a total score of 19 of a possible 75 (15 items total, highest possible score = 5) and an average of 1.6 across all 15 items (i.e., *never* to *rarely* engaged in peer-directed social behaviors).

Table 1. Demographics of children with autism at the start of the study.

Child	Gender	Age	Diagnostic instrument	Autism severity	PLS-4 SS			PECS phase	PECS prevoc
					Total	AC	EC		
Wade	M	5;1	ADOS	Severe	50	50	51	IV	50
Wyatt	M	3;9	ADOS	Moderate	62	71	60	V	100+
Zack	M	4;7	*DSMIV*	Severe	50	50	50	III	50
Haley	F	3;0	ADOS	Moderate	59	55	70	III	25

Note. PLS-4 SS = Preschool Language Scale-4 (Zimmerman, Steiner, & Evatt Pond, 2003) standard score; AC = auditory comprehension; EC = expressive communication; PECS prevoc = pretreatment PECS vocabulary size; ADOS = Autism Diagnostic Observation Schedule; *DSMIV* = *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition.*

Wyatt, age 3;9, had been attending the center for 2 years. At the start of the study he was attending 5 days/week and 7 hr/day. Wade had an expressive spontaneous vocabulary of approximately 20 words, was beginning to imitate single words after adult models, and had a repertoire of gestures to communicate wants (e.g., point, reach, and give). He was communicating using PECS at Phase V. Wyatt received 90 min of speech-language therapy and 60 min of occupational therapy per week. Teacher ratings on the SIRS also revealed limited peer interactions, with a total score of 25 and an average score of 1.7 across all 15 items.

Zack, age 4;7, had been attending the center full time for approximately 1.5 years at 5 days/week and 7 hr/day. Zach had an expressive vocabulary of fewer than 10 words, was beginning to echo single words after adult speech, and communicated with PECS at Phase III. He received daily speech-language therapy for 120 min/week, occupational therapy for 90 min/week, and daily behavioral services. His total score on the SIRS was 25 with an average score of 1.7 across all 15 items.

Haley, age 3;0, had attended the center for approximately 4 months at the start of the study. She had an expressive vocabulary of fewer than 10 words, used limited gestures (e.g., pull adult and use adult's hand), and communicated with PECS at Phase III. Her speech-language pathologist (SLP) reported that Haley required multiple adult prompts to use PECS during the school day. Haley received speech-language therapy and occupational therapy, each for 90 min three times per week. Teacher ratings on the SIRS revealed limited interactions with peers, with a total score of 24 and an average rating per item of 1.6 (i.e., *never* to *rarely*).

The seven peers were recruited from a neighborhood daycare center within walking distance of the center that the children with autism attended. The peers ranged in age from 3;4 to 4;11. The daycare staff collaborated with the center staff to have the peers attend 4 days per week for 3 hr each afternoon. All peer participants were assessed with the Devereux Early Childhood Assessment (LeBuffe & Naglieri, 1999) to confirm age-appropriate social behaviors; all received ratings of *typical* (or higher) on social areas related to initiative, self-control, attachment, and behavior on the assessment. All interested parents attended an open house at the center and received written information about the center and the research project. Interested parents reviewed and signed approved parent permission forms for consent. Peers were included in the preschool as would any child who attended the center; that is, they were provided a hook and name tag and a mail box for art work and parent communication and participated in all classroom activities. Two peers moved away shortly after the start of the intervention. Approval for this study was granted by the Human Subjects Committee at the University of Kansas, and all ethical considerations for protection of all participants were followed.

Settings

Each year, the center served about 30 children with autism, ages 2 to 10 years. Educational services provided included occupational therapy, physical therapy, speech and language therapy, behavioral programming, and TEACCH programming. The three main classrooms were birth to 2 years (early learners), 2 to 5 years (young learners), and 6 to 10 years (school age). All participants were in the same classroom (young learners) and had individual and small group therapy sessions. Each classroom was staffed by a lead teacher, a service provider (i.e., an SLP, early educator, or behavior specialist), and one or two classroom aides. The adult:child ratio was approximately 1:3. Each focus child had a PECS book that was outfitted with a standard set of core symbols, with additional symbols added or removed to individualize the books over time. The goal was to provide access and have opportunities to use PECS throughout the day.

Baseline and intervention sessions took place across preschool routines, including art (e.g., painting, play dough), sensory and fine motor activities (e.g., beading necklaces, puzzles, coloring), and activity centers (e.g., shape sorters, dolls and kitchen, trains and tracks). Sensory and fine motor activities took place in a larger gross-motor room equipped with two tables with small chairs, jungle gym equipment, sensory tunnels, a sand/water table, and exercise therapy mats. Snack time was added as a setting for two children midintervention and took place in a room that resembled a kitchen, equipped with a large U-shaped table, chairs, a sink, and a refrigerator. For one child (Wade), snack time began with only one peer in a

quiet area away from the larger group. After 2 weeks, Wade joined the larger group in the regular snack room.

Social Measures and Data Collection

Coding of all child–peer and peer–child communication occurred live during a 6-min interval within a 10–15-min social activity, using paper and pencil. Total frequency or rates of all peer-directed communication was coded for each 6-min interval. Each session was videotaped using a Flip Mino camera on a tripod set up within 6-8 ft of the dyad, and the video was later copied to an external hard drive in the lab. Communication behaviors coded were initiations and responses—defined by a 3-s pause—followed by coding of the type communication mode: (a) speech, (b) PECS, or (c) gestures. Each communication act was coded as an initiation or a response and for the following four functions: (a) gain attention, (b) comments, (c) requests, and (d) shares (see definitions in Table 2). Use of instances of initiations and responses (separated by a 3-s pause) is a more precise way to quantify specific communication behaviors and measure reciprocal interactions, although this approach makes it more difficult to achieve and maintain reliability between observers. Speech directed to an adult or prompted by an adult was not counted in the totals. Other or inappropriate behaviors were also coded and included disruptive verbalizations or physical behaviors (e.g., hitting, throwing toys, and crying), nonfunctional immediate echolalia, or unintelligible speech. The total number of communication acts for each child and their peer partner was summed and averaged across all phases: baseline, intervention, and generalization probes.

An additional analysis included engagement within dyadic play with a peer, which was also collected via a paper-and-pencil system. To measure engagement, the focus child needed to remain within 2 ft of the peer and actively participate in the activity by engaging in a minimum of one of the following: share or give toys, orient body and/or shoulders in direction of peer to show interest, listen to peer, and communicate. The child was considered to be engaged when he or she maintained one or more of these behaviors for a minimum of 45 s of each 1-min interval. Coders would mark off interval numbers 1–6 on the dependent variable coding sheet for each interval engaged. Coding engagement in this manner allowed the coders to use the same coding sheet and continue to code all primary dependent measures at the same time, given that they had an interval tape playing and could also mark engagement at 1-min intervals.

Experimental Design

A series of A-B designs with some staggering of implementation of intervention across participants was used to examine the effects of the intervention on rates of communication and engagement. Following a stable baseline over a minimum of five sessions, peer training (PT) was

Table 2. Definitions of coded communication modes, acts, and functions.

Coded item	Definition or description
Communication mode	
Speech	Child intentionally uses speech to communicate with a peer; minimum requirements to code as speech included (a) 1 consonant and 1 vowel combination; (b) approximation of words included 1 consonant matching placement in the intended word, and (c) verbalization directed to peer.
PECS	Child exchanges a symbol to intentionally communicate with a peer by selecting the symbol and giving to a peer; PECS act was coded if peer reached out and took the symbol from focus child's outstretched hand.
Communication behavior	
Initiation (FI or PI)[a]	Child initiates communicative interaction by using any communication act described above.
Response (FR or PR)	Child responds to another child's initiation or response by communicating using any communication act within 3 s of the child's initiation.
No response (FNR or PNR)	Child does not respond to another child's communication act within a 3-s interval
Communication function	
Gain attention	Requests the other child's attention (e.g., says child's name, taps child on shoulder or arm, greets)
Comment	Labels object by name, color, size, or other descriptive words (e.g., ball, blue, baby doll); acknowledges or agrees with other's comments (e.g., sure, yes, okay); socially polite words (e.g., thank you)
Requests	Requests to gain an object from a peer (e.g., ball please; I want cookie), to have an action performed (e.g., pour it; push it), or for a turn or to tell peer to take a turn (e.g., my turn; your turn)
Shares	Offers a toy or materials when items or continuation of play is requested (e.g., hands a ball to other child and says "Here" or "Here you go"); offers to help another child (e.g., "Can I help you?" "Let me do it")
Other	Disruptive or inappropriate vocalizations, verbalizations, or physical behaviors (e.g., hitting, throwing toys, yelling, crying); echolalia, stereotypic utterances, animal noises, or unintelligible utterances; stereotypic or pervasive behaviors deemed to be self-stimulatory, interrupt the play, and take peer's attention from current activity.

Note. FI = focus initiation; PI = peer initiation; FR = focus response; PR = peer response; FNR = focus no response; PNR = peer no response.

[a]Initiations were separated by a 3-s or greater pause; thus, multiple or new initiations from either peer or focus child were coded after a 3-s pause following any initiation or response.

implemented for an older group of four peers over two consecutive weeks; baseline data collection continued for the younger group of three peers plus Haley. Peers in the younger group were then trained over the course of the next two consecutive weeks, while the center staff began the intervention with the three older boys and their trained peers in the classroom. Implementation of this intervention was staggered across the boys by one intervention session per child, and Haley's baseline sessions extended into the intervention period for the three boys. Once PT started for a peer group, child–peer dyadic observations in the classroom were suspended. For two children, effects were also measured in an additional setting (snack time).

Procedure

Baseline

Baseline ranged from five to seven sessions, with data collected over a period of 8 weeks. During baseline, one child with autism was paired with one peer. Peers rotated into each dyad; the four older peers took turns with the three older boys with autism, and the three younger peers took turns playing with the youngest girl, Haley. The teacher explained the activity and told the pair to stay at the table and play nicely for 10–15 min. Frequency rates of all dependent measures were collected live during the 6-min coding interval. No adult prompts were provided unless a child left the group and needed redirection to return. A minimum of three picture symbols were placed on the front Velcro strip of a black 8- ×10-in. three-ring binder: one or two symbols of objects that were part of the social activity and two symbols depicting social phrases (e.g., "Look!" or "Let's play"). Multiple pages with other picture symbols were placed inside the binder. The book was placed between the focus child and the peer and remained on the table throughout the activity. One child, Haley, continued in baseline while PT was taking place for the older group of peers.

PECS PT

Along with the first author, two center staff participated in all PT sessions: one SLP and one special education teacher (the fourth and fifth authors, respectively). PT occurred over four different days for 30–45 min each session in a quiet room. Seven peers were trained in two groups because of center staff time demands and the age of the peers. Children with autism did not attend PT. Peers were taught responsive social skills modified from the evidence-based preschool intervention Stay-Play-Talk. Modifications included (a) breaking down the first two steps (*stay* and *play*) into two substeps with corresponding pictures and words created to match each skill, (b) incorporating skills to teach PECS use within the last PT step (*talk*), and (c) adding a session on 'more ways to talk" for other facilitative social and communication skills. Components of all PT sessions included (a) pictures and written examples of all skills on a wipe-off board, (b) provision of a buddy book with colored pictures and words to describe each step taught, (c) adult–adult role play of each skill, (d) adult–child role play of each skill, (e) child–child role play, (f) adult feedback, reinforcement, and prompts as needed for encouraging skill use, and (g) review of steps taught (see Supplemental Material S1).

PECS and Pals Intervention in the Classroom

Following PT, one of the trained peers was paired up with one child with autism for a 10–15-min activity. Child–peer activities were set up one or two times per day, approximately 2 days/week and were guided by the SLP and special education teacher (who participated in the PT) and a third implementer, who was an occupational therapist. The peers took turns in the dyad; therefore, each peer participated approximately once per week. Nine to 25 intervention sessions took place over 9–16 weeks. One child (Wyatt) left the center after 9 weeks of intervention to attend a public school. The PECS binder was placed between the focus child and the peer child. Just before the activity, the school staff implementer followed a list of eight intervention fidelity steps (see Supplemental Material S1) that were laminated on a card. Once the directions were explained and just before the start of the data collection interval, the adult moved behind the child dyad and observed their interactions. When no interactions were noted after approximately 30 s, the adult prompted the peer to prompt the focus child to initiate a request using a picture symbol. Prompts were provided in a least-to-most hierarchy: (a) peer held up desired object and waited 5 s for a response, (b) peer held up desired object and pointed to the picture symbol on the book, (c) peer took the symbol and put it in the focus child's hand and asked, "Want ____?" or (d) adult prompted the focus child by touching elbow or hand to initiate picture exchange with peer. Adults provided regular positive verbal praise to peers for following the Stay-Play-Talk steps and to the focus children for communication acts or attempts.

Social communication measures were collected for a total of 6 min during each 10–15-min activity. Research staff coached the implementers as necessary to ensure the dyad had a minimum of two opportunities to communicate every minute (i.e., 12 times per 6-min session). No prompts were provided when the dyad engaged in spontaneous communication with or without using a picture symbol. To examine whether a change in context would increase child motivation and rates of communication with peers, snack time was added as an activity for Wade after 13 intervention sessions and for Zach after 10 intervention sessions. Center staff encouraged child–peer interactions outside of data collection times for this study, primarily during times in activity centers, which allowed for free-play interactions. As opportunities arose naturally, staff implementers reported that they would occasionally prompt the focus child to use PECS to request objects from a peer.

Generalization Probes

Data for two or three baseline generalization probes and two to four generalization probes were collected during the intervention phase. These probe data were collected for 6 min during dyadic play with a trained peer at a table

in an empty preschool classroom. One switch toy from a collection of three different toys was presented in all generalization probes. All toys had lights, sounds, and movement, with the goal of increasing child motivation to communicate. The PECS book was available, and no adult prompts were provided during these probes.

Data Analysis

A combination of visual and effect size statistical analyses were used to evaluate the effectiveness of the intervention on increasing rates of child–peer and peer–child communication behaviors and on levels of engagement in dyadic play. Visual analysis of the graphical display of data included differences between phases in variability, mean, and trend. Tau effect sizes (Parker, Vannest, Davis, & Sauer, 2011) were calculated to provide a quantitative measure of the degree of change between baseline and intervention phases for each child with autism and for the peer partners, and these values were combined to obtain an overall Tau effect size for each group. Tau is a method for measuring data nonoverlap between two phases (i.e., A and B). Tau effects sizes of <.5, .5–.69, and .70–1.0 are interpreted as minimal to no effect, moderate effect, and a large effect, respectively.

Reliability

Two research assistants completing master's degrees in speech-language pathology were taught to code dependent measures to a criterion level of 80% using video clips of similar groupings of children from a previous study, with one peer and one child with autism engaged in play. The first author then coded in vivo with each research assistant to establish an interobserver agreement level of 80% or greater over three different days at the center. A minimum of 30% of all experimental sessions were coded for reliability, communication mode (speech, PECS, or gesture), behaviors or acts (initiations, responses, or no responses), and functions (gain attention, comment, requests, or shares). A prerecorded 15-s tape was positioned next to the video camera microphone to assist with interobserver reliability coding. When possible, data were independently coded by the first author and one of the trained research assistants simultaneously during the play session. When this coding approach was not possible, the research assistant coded from the session video, which was saved to an external hard drive and then viewed on a computer in the lab. For communication, agreements were scored when both observers coded the same mode, act, or function within the same interval. Disagreements were scored when the two coders did not agree on the type of mode, act, or function of the act or when one coder did not observe a communication act. Percent agreement for each of the three communication measures was calculated separately by dividing the agreements by agreements plus disagreements and then multiplying by 100 to yield a percentage. The average interobserver reliability was 84% for all communication acts (range, 67%–100%), 87% for communication mode (75%–100%), and 99% for function of the communication act (90%–100%).

Teacher Fidelity of Implementation

Following PT, implementers were provided with a list of steps to follow to ensure fidelity of implementation of the intervention (see Supplemental Material S1). Research staff observed implementer implementation and completed the checklist for a total of 35% of the intervention sessions. Fidelity of intervention was 75%–100%, with an average of 90% across all sessions.

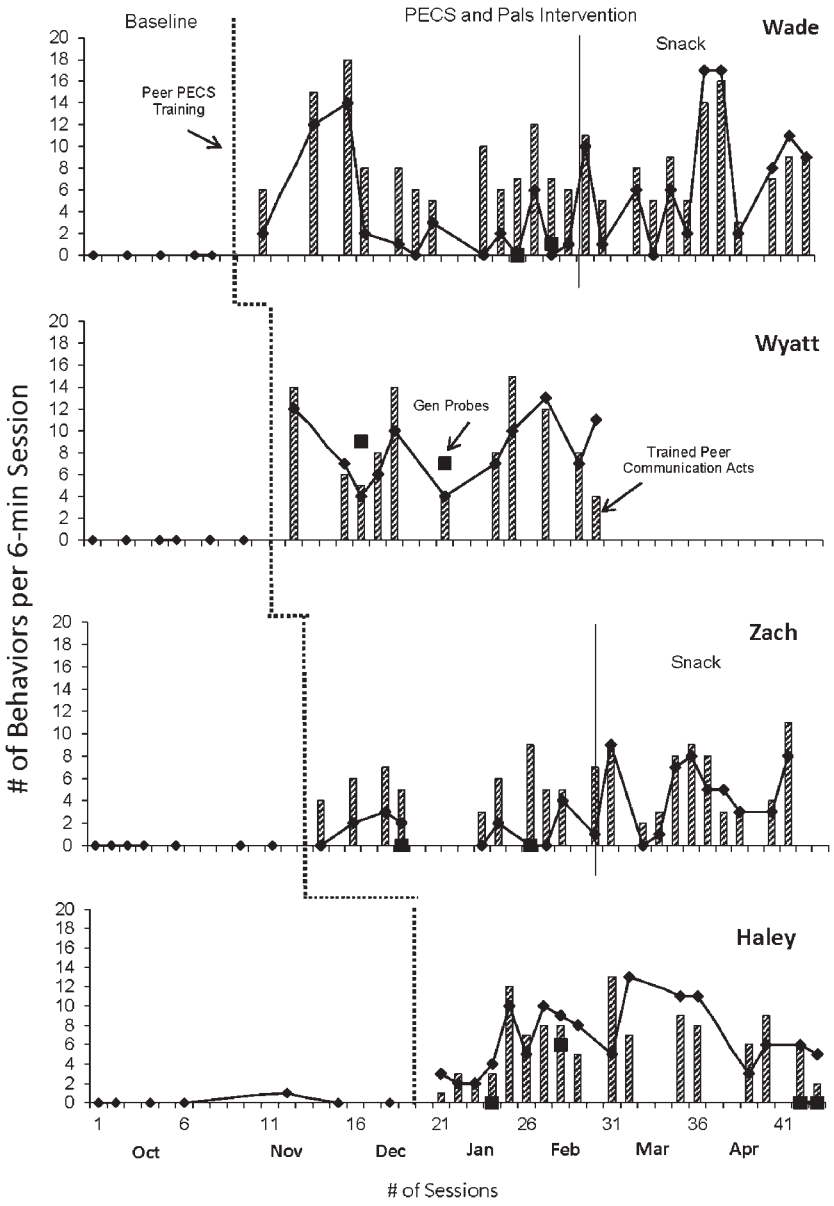
Results

Figure 1 shows rates of total communication acts over time. The line graph shows the total number of unprompted initiations and responses for the focus children with autism who were directed to a trained peer, and the bar graph shows the total number of unprompted initiations and responses for the trained peers who were directed to the child with autism. Prompted use of communication behaviors by adults is not included. Baseline data collected for the trained peers ranged from 0 to 1 act; these data were not graphed and are summarized below. Data summarizing communication modes and functions for the focus children with autism are also described.

Focus Children's Social Communication

Visual analysis revealed that during baseline, Wade did not engage in any communication acts with his peers ($M = 0$) during play. Following PT, Wade demonstrated immediate increases in communication behaviors to peers, to an average of 5.3 acts per session over the duration of the intervention (25 sessions). However, Wade's communication behavior rates were variable; higher rates of using PECS to request puzzle pieces (a preferred activity) were noted during intervention sessions 2 and 3. For the following 10 intervention sessions, his rates fluctuated, even when puzzles and other recommended preferred toys were provided. At this point midintervention, snack time was added as a setting to determine whether his communication to peers would increase and/or be more consistent based on food preferences. This change resulted in increased communication to peers, from an average of 3.3 acts in activity centers and during play routines to an average of 7.4 acts during snack time. The majority of Wade's communication was through PECS (96% of all acts), and in three instances he combined PECS with speech (2% of acts) or used a gesture (2%). The primary function of Wade's communication to peers was to make requests (98% of all acts); he rarely communicated for the purpose of sharing toys (two acts) or gaining a peer's attention (one act). During two generalization probes during baseline, Wade did not communicate to peers; he communicated once to a peer across two 6-min generalization probes midintervention.

Figure 1. Total number of spontaneous communication acts per 6-min social activity during baseline and intervention between children with autism and trained peers. Bar graphs indicate spontaneous peer communication directed to the focus child.



This intervention effect was replicated for Wyatt. He was also observed to have zero communication acts during baseline. Immediate treatment effects were observed following the intervention, and these rates remained consistently higher compared with baseline for the duration of the intervention for an average of 8.3 acts per session. Wyatt's intervention ended early, after 11 sessions, because his family moved out of the district. During the intervention, his primary mode of communication to peers was PECS (66% of all acts), followed by speech (19%), then gestures (12%), and he combined speech and PECS use on three occasions (3%). He showed improvements across three different communicative functions: 79% of his communication acts were requests, 11% were shares, and 10% were comments. Communication also increased during the generalization probes, from an average of one act during baseline to an average of eight acts during two midintervention probes with the switch toys.

Zach's data also revealed replication of the intervention effect following the start of the PECS and Pals interventions. His communication to peers was absent during baseline ($M = 0$), and although his communication behaviors were variable, Zach's average communication acts increased to 3.2 over the duration of the intervention. Given this variability, snack time was added as a setting to determine whether communication would increase based on food as a preference. Higher rates on average were obtained during

snack time, with an increase from 1.5 acts during activity center and play routines to 4.9 acts during snack time. His primary communication mode was using PECS with peers (57% of all acts), followed by combining PECS with speech (32% of all acts), and using speech alone (11% of acts). Zach communicated to peers primarily to make requests for objects (98%), and on one occasion he expressed a comment. Baseline communication during the two generalization probes was 0, and Zach did not generalize communication to peers during the two probes at midintervention.

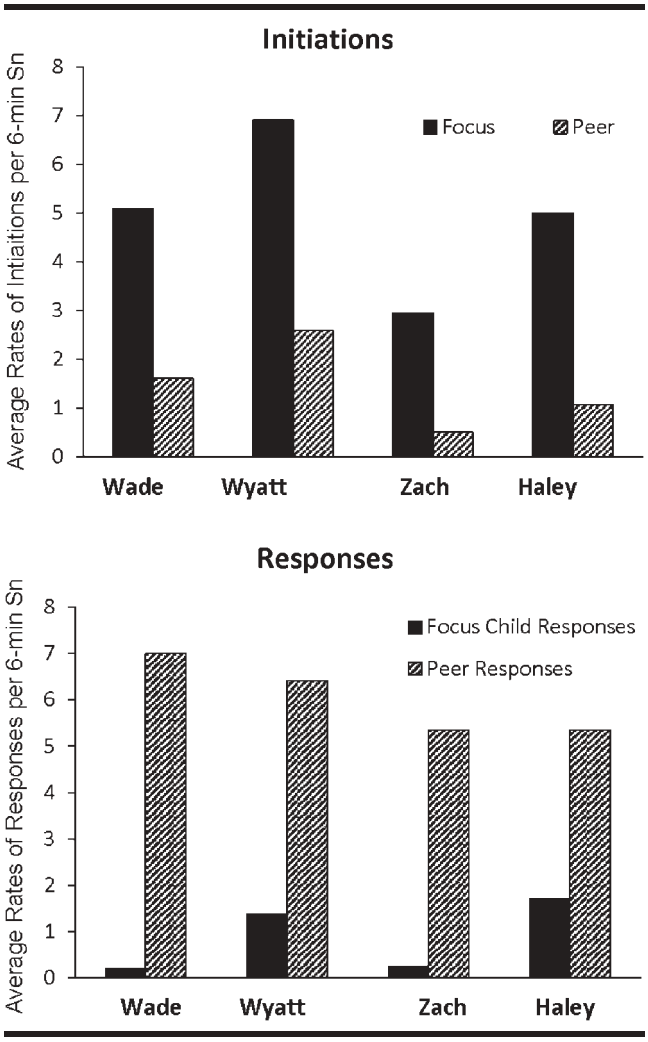
Haley communicated to her peer once during baseline ($M = 0.1$). Effects of the PECS and Pals intervention were again replicated and notable, with increases to an average of 6.6 acts per session observed over the course of the intervention. Her primary communication mode was using PECS (64% of the time), followed by gestures (17% of acts), and speech (12%), and she combined PECS and speech on nine occasions (8% of all acts). Her primary reason for communicating to peers was to make requests to ask for objects or ask for turns (80% of all acts). Haley also communicated for the purpose of sharing toys (12% of acts) and occasionally made comments (9% of all acts). She communicated once to a peer during the three baseline generalization probes ($M = 0.3$) and six times across four intervention probes ($M = 1.5$).

Trained Peer's Social Communication

Following PT, spontaneous communication acts directed to the children with autism increased for all trained peers during dyadic classroom interactions (see Figure 1). Baseline rates of peer communication ranged from an average of zero to 0.3 acts per session. Intervention effects on rates of initiations and responses were most noticeable for Wade and Wyatt's peers, increasing from an average of 0.2 acts at baseline to 8.6 and 8.9 acts, respectively. Effects also were replicated for Zach's peers, with an increase in communication acts from zero at baseline to an average of six acts per session during the intervention. Similarly, Haley's peers began communicating with her at higher rates, from an average of 0.3 acts per session at baseline to 6.4 acts during intervention. A closer examination of the type of communication act—initiation or response—revealed that the peer's responsiveness to the focus child's communication increased more than did initiations, at 5.4 to 7.0 responses on average per session compared with 0.5 to 2.6 initiations per session. These data reflect the nature of the PECS intervention, given that the majority of communication acts by the children with autism were to request objects from the trained peer by giving a picture symbol; the peer then responded by giving the object (see Figure 2).

To determine whether peer partner differences accounted for some of the variability in focus child communication behaviors measured during the intervention phase, we ascertained which trained peer partners were paired up (primarily) with each of the focus children. We then calculated average rates of focus child communication acts observed during sessions with each individual peer partner.

Figure 2. Average rates of initiations and responses by focus children with autism and their trained peers per 10-min session during the intervention. Sn = session.



Results revealed that the same two trained peers (Peer 1 and Peer 2) were primarily paired up with Wade and Wyatt. Wade communicated at rates of 4.3 acts per session with Peer 1 and 6.1 acts per session with the Peer 2. Wyatt communicated using an average of 8.5 acts with Peer 1 and 8.8 acts with Peer 2. These two same peers were primarily paired up with Zach, along with a third peer (Peer 3). Zach directed an average of 3.4, 2.3, and 3.0 communication acts per session to Peers 1, 2, and 3, respectively. Peer 1 and Peer 2 participated equally across these three focus children. Given the observed limited range of child communication acts directed to each of the child's peer partners, it is unlikely that variability in behaviors for these three older boys could be explained by peer partner differences. Two additional trained peers (Peers 4 and 5) participated with Haley, who had an average of 6.0 communication acts with Peer 4 and 9.0 acts with Peer 5. Thus, peer partner differences could account for some of the variability in Haley's communication during intervention.

Statistical Analyses for Focus Children and Trained Peers

Statistical analyses using Tau revealed large effect sizes with the implementation of PECS and Pals interventions for all four children with autism. Calculated effect sizes indicated a large change between baseline and intervention for Wade (.80), Wyatt (1.0), Zach (.75), and Haley (1.0) respectively. The combined calculated Tau across all four children with autism also indicated a large magnitude of change (.88). Analyses for the peer partners demonstrated similar large effect sizes between baseline and intervention, with a Tau of 1.0 for Wade's, Wyatt's, and Zach's peers and .98 for Haley's peers. Combined calculated Tau for all peers indicated a large magnitude of change (.99).

Engagement with Peer

Figure 3 shows time engaged in the dyad with a trained peer for the children with autism. At baseline, engagement was variable for all children, ranging from zero to six intervals engaged. After the start of the intervention, Wyatt had immediate and consistent engagement with his peer, with engagement observed in all six intervals across 11 intervention sessions. Wade and Zach continued to show variable engagement with their peers during routine center, sensory, and play activities; however, once snack time was added as a setting, rates of engagement became stable and high for both boys. Wade stayed engaged for the entire 6 min for the next 11 of 12 intervention sessions (one session he was engaged for 5 min), and Zach was engaged with his peer partner for 9 of the next 10 intervention sessions (one session engagement was 5 min). During her third intervention session, Haley's engagement with her peer increased to six intervals, and she maintained high levels of engagement for the remaining intervention sessions.

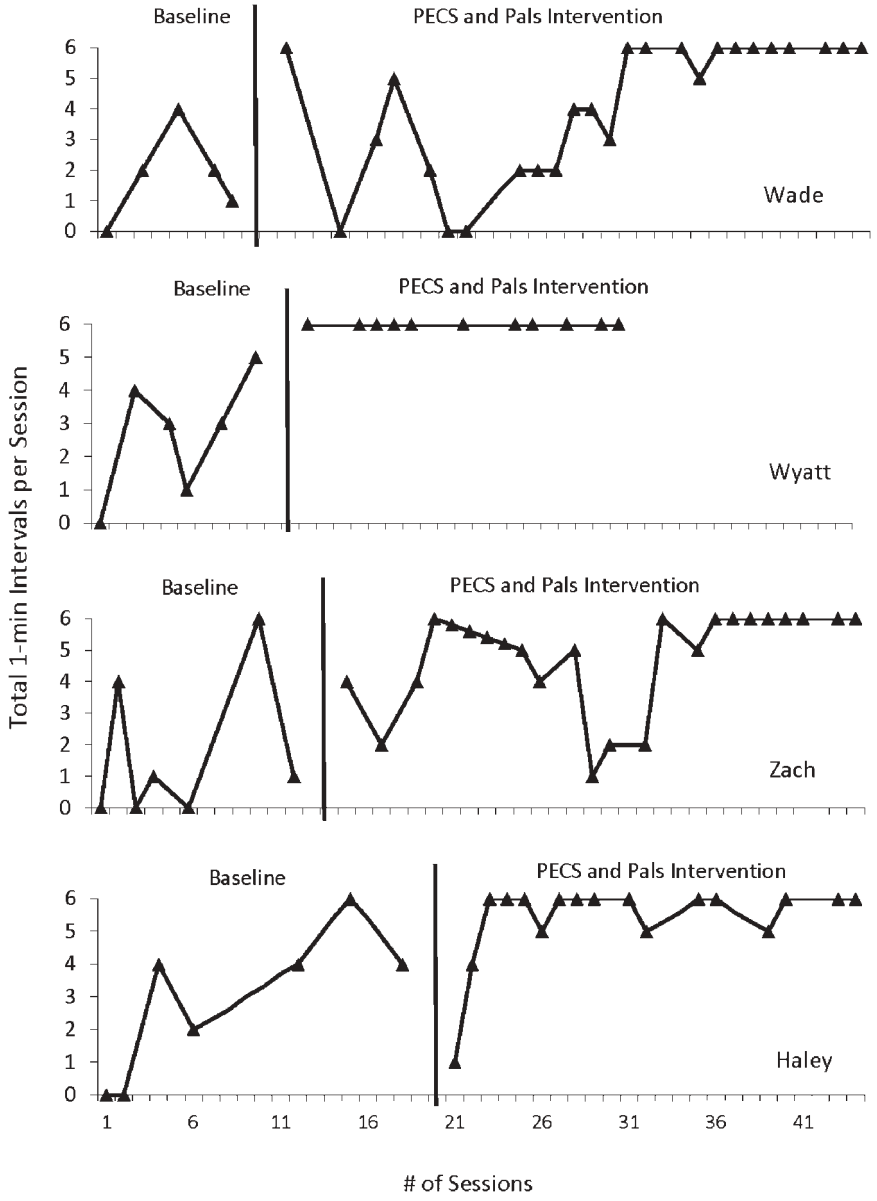
Discussion

Clinical and research guidelines exist for training communication partners to use specific AAC interaction strategies with individuals with autism and other DDs (Light, Roberts, Dimarco, & Greiner, 1998), yet to date these recommendations have primarily included adults as listeners. Mirenda (2008) eloquently challenged current assumptions about autism and commonly used AAC instructional teaching strategies (e.g., adult prompts, fading, reinforcement strategies) and suggested the need for more flexible and viable augmented input techniques to support communication. Supporting communication by training peers to use AAC methods—for example PECS as in the current study—is one way to address this need. An empirically supported peer-mediated intervention, Stay-Play-Talk (English, Goldstein et al., 1997; English, Shafer et al., 1997; Goldstein et al., 1997), was modified to provide opportunities for all children to communicate using PECS. The results were compelling, with increased communication for four children with autism and five peers without disabilities. Consistent and greater improvements were noted for two children with autism during snack time. The outcomes provide evidence for the effectiveness of combining peer-mediated intervention and PECS to teach young children with autism and their peers to communicate in natural social settings. In addition to adding to the AAC literature by including peers as communication partners, the study also fills a gap by providing measures of peer communication and specific PT steps for intervention fidelity.

The intervention model in this study was based on measuring social and communication outcomes in natural environments within typical preschool interactions. One goal of increasing successful child–peer social exchanges is to create higher levels of natural social reinforcers. When children with autism are motivated by social reinforcers, these children also may better engage in social activities—a prime time to observe and learn from peer models. Thus, teaching children to use the same communication system in natural contexts may lead to greater motivational and observational learning or a desire to engage with and imitate peers, which are precursors to learning essential early social communication skills (Garfinkle & Schwartz, 2002). Evidence to support this model comes from our observations of improvements in child engagement, PECS use, and verbal communication following implementation of the direct peer instruction. Time allotted for the peer instruction was 2 to 3 hr on 4 days; due to limited staff resources, the training took place over a period of 4 weeks. These preliminary findings add to our understanding of how to more efficiently teach peer communication partners to be attentive listeners and users of AAC systems with classmates with autism. Additional research is necessary to examine the time required to train peers within this type of intervention to increase feasibility of application by SLPs, teachers, and early education staff.

Although improvements in communication to peers was impressive based on changes to the focus children's overall communication repertoires, the intervention increased requesting skills but had limited effects on other communicative functions. The children's most frequent reason to communicate to peers was to initiate a request to gain an object. Three of the four children also communicated to a lesser degree to share toys in play (e.g., offer or give toys) in response to a peer request, and two children used PECS and/or verbal utterances to make occasional comments. The high rates of initiations to request objects was not surprising, given that PECS instruction is based on child initiations, and the first four phases of training focus on teaching children to request preferred items or to answer "What do you want?" to request in Phase V (Bondy & Frost, 1994). None of the children with autism had reached Stage VI of PECS before or after the intervention, which the authors of PECS describe as a phase when children learn to comment. However, the most common type of communication behavior by peers was responses, with fewer initiations. In considering the significant language deficits characteristic of children with autism, additional research is needed to examine components of AAC interventions that

Figure 3. Total intervals the children with autism remained engaged with their peer partner during baseline and intervention sessions (total of six intervals possible).



can lead to improvements in a wider variety of skills so these children can communicate for different purposes. For example, training peers to use a speech generating device would allow for programming of symbols to express a wider variety of communicative functions (e.g., comments, secures for attention, protests, requests) and more balanced exchanges (i.e., increased rates of both initiations and responses) without placing the peer in the position of responder.

For two children with autism in this study, consistent levels of engagement and increased communication were observed when the context was changed to snack time. Recent research on how the ecological features of preschool classrooms may have an impact on social engagement for children with autism has revealed greater social engagement with peers in food or snack areas of the classroom than in other areas (Reszka, Odom, & Hume, 2012). Reszka et al. (2012) proposed that the structure of meal time with peers may be a prime time for children to interact with greater frequency. We believe this was the case for one child, Wade. At first, snack time took place in a quiet room with one peer away from the larger group. Wade would leave the peer and seek out the adult implementer who was watching from the hall. Once redirected, Wade would exchange a symbol with the peer, yet at the same time, express frustration through vocalizations and turning away once he received the snack. Within 3 weeks, Wade was

exchanging PECS more frequently with his peer, he did not turn away, and he showed positive affect. Both children then rejoined the class, and Wade continued to use PECS consistently with this peer and another trained peer. Wade's ability to transition from using PECS with an adult, something he had been doing for almost 1 year, to exchanging pictures with a peer was difficult and required greater adult support. Interacting during snack time with his peers eventually became a successful social time based on continued positive effect and higher rates of communication. For Zach, it was less clear whether snack time was a more social time for communicating with peers or his communication was more instrumental in nature to obtain preferred food items. With adult listeners, Zach was capable of exchanging approximately 50 picture symbols that represented a wide range of preschool vocabulary. For some children, snack time may provide increased motivation to communicate with peers—a skill that is not inherent—and over time, with adult-guided success and responsive peer partners, the desire to interact for more social purposes will improve and possibly extend to other social situations.

One reported benefit of the PECS teaching protocol is embedding generalization strategies within the teaching phases—that is, children are taught to request different items with different communication partners across multiple settings (Frost & Bondy, 1996; Schwartz et al., 1998). Within this study, generalization of PECS with peers was observed for one child, Wyatt, across a novel set of toys in a new location. For the other three children, adult prompting was required for generalized communication exchanges with a trained peer. These results were surprising, given that the weekly dyadic play activities varied during the intervention. When the children were moved to a quiet room away from the regular classrooms, this extreme change may have made the transition too difficult. Another possibility is that given the marked deficits in social interaction, communication, and play skills for these children with autism, a longer period of intervention may be needed to impact generalized skill use with peer play partners.

Limitations

Although we reported high levels of treatment fidelity for the adult implementers, one weakness of this study was the lack of formal measurement of social validity through such mechanisms as peer, parent, or preschool teacher report of changes in the quality and quantity of social communicative interactions. Future studies of the effectiveness of peer mediation and AAC strategies should include measures of fidelity of peer implementation of intervention steps. Although the PECS and Pals interventions had robust effects on the children's communication and engagement, generalization to novel toys was limited. Additional post-treatment generalization sessions and measures of changes in communication with untrained peers are recommended. Implementation of the intervention for a longer time would have strengthened the design to measure the maintenance of treatment effects. Given the reported collateral gains in speech and language skills following AAC interventions with adults as communication partners, additional measures of secondary gains in these developmental areas with peer communication partners is warranted. Resources for this study were limited and did not allow investigation of such secondary outcomes.

Conclusions

A noteworthy feature of this study was the involvement of peers without disabilities and examination of an intervention that trained these peers to use PECS to be more effective communication partners for minimally verbal preschool children with autism. Once trained, all peers could independently receive pictures and exchange objects with their classmates in inclusive settings, with few adult prompts. The effects, replicated across four children, could be clearly attributed to the onset of the PECS and Pals interventions. The results extend those of English and colleagues (English, Goldstein et al., 1997; English, Shafer et al., 1997) for young children with autism learning to use PECS as an AAC system and expand on the limited available research documenting how to train peers and how to measure peer communication outcomes. The results suggest that researchers should attend to features of the environment that may increase communication and engagement and perhaps begin by including settings that will motivate children to interact with peers, such as snack time. Outcomes are promising given the significant social and complex communication needs of the children with autism. Future research is warranted to examine the effectiveness of interventions to teach peer partners to use other types of AAC systems such as speech generating devices to create more balanced and reciprocal social interactions between children with autism and peers without disabilities.

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