

The Effects of PECS Teaching to Phase III on the Communicative Interactions between Children with Autism and their Teachers

Deborah Carr · Janet Felce

Published online: 28 September 2006
© Springer Science+Business Media, Inc. 2006

Abstract The study investigated the impact of mastery of the Picture Exchange Communication System (PECS) to Phase III, on the communications of children with autism. Children aged between 3 and 7 years, formed a PECS intervention group and a non-intervention control group. The intervention group received 15 h of PECS teaching over 5 weeks. Three 2-h classroom observations recorded communications between the children and their teachers. These occurred: 6 weeks before teaching; during the week immediately prior to teaching; during the week immediately following teaching. For the control group, two 2-h observations were separated by a 5-week interval without PECS teaching. Communicative initiations and dyadic interactions increased significantly between the children and teachers in the PECS group but not for the control group.

Keywords PECS · Communication · Children · Autism · Teachers

Introduction

It has been estimated that up to 80% of children with autism who enter education at 5 years old or younger have extremely limited language; either they do not speak at all or their speech is confined mainly to self-stimulatory or echolalic utterances (e.g., Bondy & Frost, 1994a; Kraijer, 1997). Studies on longer-term

outcomes have estimated that between one third and two thirds of children with autism never acquire useful spoken language (e.g., Charlop & Haymes, 1994; Lord & Paul, 1997; Weitz, Dexter, & Moore, 1997).

The effectiveness of applying behavioral procedures to teaching children with autism to speak and to increase their use of language in their everyday environment is well documented (e.g., Charlop & Trasowech, 1991; Charlop & Walsh, 1986; Charlop, Schreibman, & Thibodeau, 1985; Halle, Marshall, & Spradlin, 1979; Hart & Risley, 1980; Koegel, Koegel, & Schreibman, 1991; Lovaas, 1987; Sallows & Graupner, 2001; Smith, Eikeseth, Klevstrand, & Lovaas, 1997). Nevertheless, teaching speech is an intensive and lengthy process and meanwhile children participating in such programs lack an effective means to communicate functionally. Furthermore, social-communication deficits are evident in children with autism, whether the child is being taught spoken language or a means of augmentative communication. Current recommendations for best practice take account of the range of difficulties exhibited.

Many children with autism do not initiate communication easily, using either spoken or augmentative language; therefore giving a high priority to overcoming prompt dependence and promoting spontaneous communication has been strongly recommended (e.g., Carr & Kologinsky, 1983; Charlop & Haymes, 1994; Charlop & Trasowech, 1991; Charlop & Walsh, 1986; Charlop et al., 1985; Halle et al., 1979; Potter & Whittaker, 2001; Reichle, Sigafos, & Remington, 1991). Additionally, the communications of children who are just beginning to learn either spoken or augmentative language are often difficult to understand. This limits the effectiveness of early efforts to

D. Carr (✉) · J. Felce
Welsh Centre for Learning Disabilities, Division of Psychology, Cardiff University School of Medicine, Neuadd Meirionnydd, Heath Park, Cardiff CF14 4YS S Wales, UK
e-mail: debcarr60@hotmail.com

communicate and compromises further development of communication in these children (e.g., Halle, 1984; Yoder & Warren, 1993). Therefore, providing the individual with a system of communication that is both clear and easy to use has been highlighted as an essential element of communication enablement (e.g., Potter & Whittaker, 2001; Van der Gaag & Dormandy, 1993). A further consideration is that children with autism are less motivated by social effects of communication, such as praise, shared attention or interaction, than they are to its concrete effects, such as obtaining a desired item (e.g., Bondy & Frost, 1998; Halle, 1984; Prizant & Wetherby, 1987; Wetherby & Prutting, 1984). Therefore recommendations for best practice advocate embedding communication teaching within the context of the everyday activities and events that most motivate the child to communicate (e.g., Halle, 1984; Koegel, O'Dell, & Koegel, 1987; Potter & Whittaker, 2001; Remington, 1998; Schuler, Prizant, & Wetherby, 1997; Yoder & Warren, 1993).

Incidental teaching procedures for facilitating the verbal communication of children with autism in the natural milieu have been developed and evidence of their effectiveness is accumulating (e.g., see review by Goldstein, 2002). Incidental teaching procedures incorporate many of the aforementioned communication enablement recommendations. Desired items and motivating events are used as the basis for promoting verbal communication; prompt dependency is limited by delaying prompting by the teacher or facilitator. Instead, cues to communicate are transferred to items and events in the child's natural environment. There is also a heavy emphasis on employing turn-taking strategies whereby the child is accorded shared control with the communicative partner. This maximizes both the child's motivation to participate and the frequency of communication opportunities presented to him or her. A wide range of communicative functions has been addressed in children with autism using incidental teaching procedures, including spontaneous requesting (Charlop et al., 1985; Koegel et al., 1987); reciprocal interactions (e.g., Laski, Charlop, & Schreibman, 1988; McGee, Almeida, Sulzer-Azaroff, & Feldman, 1992); elaboration of language (e.g., McGee, Kranz, & McClannahan, 1985) and increasing speech intelligibility (Koegel, Camarata, Koegel, Ben-Tall, & Smith, 1998).

Incidental teaching procedures focus on facilitating the use of spoken communication in children with autism and therefore they require at least a minimal spoken repertoire as a prerequisite. The Picture Exchange Communication System (PECS) (Frost & Bondy, 1994, 2002) was developed in response to the need for an effective communication system for chil-

dren with autism, which did not delay their access to communication by relying entirely on the time-consuming and difficult process of establishing speech. The system is based on the exchange of picture or symbol representations for desired items and events. PECS teaching protocols systematically employ applied behavior analytic procedures (e.g., task analysis, prompting and fading, chaining) to develop the required repertoire. However, it is not intended that teaching be delivered in a massed trial format; rather, it is embedded in the child's most motivating daily activities. This provides the kind of loose training environment with multiple exemplars, which are recommended in the behavior analytic literature as effective strategies for promoting generalization of functional behaviors (Stokes & Baer, 1978). PECS advocates that communication training should begin with teaching requests for effective concrete reinforcers in order to promote and capitalize on the children's motivation to initiate spontaneous communicative approaches. The teaching procedure provides a clear structure of prompting and prompt fading, designed to avoid obstruction of spontaneous communication due to prompt dependence; eventually, communicative partners wait without prompting in order to encourage independent approaches from the child. Furthermore, because PECS is intended as an augmentative communication system for children with autism who have not yet learned, or who may never learn, to speak, its teaching protocols are aimed at minimizing the need for training prerequisite behaviors in order to access the system (Bondy & Frost, 1998). Although the initial aim of PECS teaching is to establish robust, spontaneous requesting, later teaching phases are designed to promote elaboration of augmentative language with sentence-building, use of attributes, commenting, and responding to the initiations of others.

Frost and Bondy (1994, p. 3) defined the central aim of PECS thus, "Children using PECS are taught to approach and give a picture of a desired item to a communicative partner in exchange for that item. By doing so, the child *initiates a communicative act* for a *concrete item* within a *social context*." [italics added].

After a detailed assessment of the child's reinforcing items, teaching is conducted over a series of six phases, each with its own specific goal:

Phase I. Teaching the child to initiate a request for a desired item through the exchange of a picture for that item, at close proximity to a communicative partner. A single picture is presented on the communication book. Phase I is mastered and generalized when the child is making picture exchanges independently for 3–4 different items with a variety of different people.

Phase II. Teaching the child to travel to a communicative partner in order to initiate a request for a desired item, in order to increase spontaneity and persistence in their communicative initiations. Phase II teaching is ongoing throughout the PECS teaching programme in order to maximize generalization of picture exchange across items, persons and situations.

Phase III. Teaching the child to exchange the correct picture for an object by teaching them picture-to-object discriminations and their corresponding object-to-picture relations. Discrimination teaching is ongoing as more pictures are added to the child's collection.

Phase IV. Teaching the child to construct and exchange "I want" sentences, using the sentence strip with an "I want" symbol plus an "item" symbol.

Phase V. Teaching children to respond to "What do you want?" using the sentence strip.

Phase VI. Teaching children to comment spontaneously and in response to a question, e.g., "What do you see?", "What do you have?"

There is currently a lack of controlled research studies on the efficacy of PECS. Research has been limited mainly to retrospective reports (Bondy & Frost, 1994a, 1994b, 1998; Schwartz, Garfinkle & Bauer, 1998; Webb, 2000), a multiple baseline study across three subjects (Charlop-Christie, Carpenter, Le, LeBlanc, & Kellet, 2002), and most recently, an independent pilot evaluation study (Magiati & Howlin, 2003). Bondy and Frost (1994a) retrospectively reported longitudinal data for 66 children with autism aged 5 years or younger, who were included in the Delaware Autistic Program. Their cognitive abilities were not assessed formally but were estimated to range from mild to profound intellectual disability. The data revealed that after 1 year or more of starting PECS, 59% of the children were able to use speech without pictures to communicate, 20% used a combination of speech and symbols and 7% were able to use pictures effectively, although they did not develop speech. Webb (2000) reported retrospectively on six children with developmental and language disabilities, five of whom had autism, and who were aged between 4 years, 7 months and 5 years, 10 months. All the children were using between 112 and 160 symbols each after 6 months of starting PECS. Furthermore, their number of spoken words increased from a mean of 10 to a mean of 68 words. The sample of preschool children in the study by Schwartz et al. (1998) consisted of half with a diagnosis of autism or PDD Not Otherwise Specified (PDD-NOS) and half with more generic developmental disabilities. It was reported that all the children in this heterogeneous group had learned to use PECS effectively after an average of 14 months. Outcomes after a

1-year follow-up showed that eight children had 5 or more spontaneous words and ten had fewer than 5 words in their expressive vocabulary. An applied behavior analytic study with three children with autism aged 12 years, 5 years 9 months and 3 years 8 months, all of whom had profound expressive and receptive communication disability, demonstrated substantial gains in spontaneous speech and imitation and decreases in instances of challenging behavior after acquiring the skills for all six PECS phases (Charlop-Christie et al., 2002). The pilot evaluation study with 34 children with autism and a mean age of 7.8 years revealed skill acquisition across a range of dimensions, including PECS Phase, number of pictures used and frequency of PECS use. Additionally, there were modest but significant increases in the children's use of manual signs, words and phrases as well as their levels of spontaneous communication (Magiati & Howlin, 2003).

All the aforementioned studies have focused on the communicative initiations of children after PECS teaching and on the expansion of their picture-based and longer-term spoken vocabularies. Although the current evidence for the effectiveness of PECS is positive, it is limited because experimental control was absent in most of the studies. Exceptionally, Charlop-Christie et al. (2002) used a multiple baseline experimental design across settings with their three participants. However, their positive findings with just three individuals with autism are not generalizable to the population of children with autism.

The purpose of the current study was to conduct an experimentally controlled investigation into whether developing spontaneous communicative initiation through the early phases of PECS (Phases I, II and III), may have corollary effects on the dynamics of communicative interactions between children with autism and their teachers. These three phases are specifically under investigation because they provide the primary focus of PECS teaching, which is to develop spontaneous communicative initiation in children with autism. Measurement of the children's communicative behaviors was designed with reference to current understanding of communicative intent in children with autism (Prizant & Wetherby, 1987; Schuler et al., 1997; Wetherby & Prizant, 1989). These authors' analysis of the communicative behaviors of children with autism concluded that although immediately recognizable communicative initiations by children with autism are considerably less frequent than for typically developing children, they do demonstrate intent to communicate through a range of observable, preverbal and nonverbal behaviors. Therefore the chosen method of measurement was direct observation using a

purpose-designed observation instrument. This was coded according to the behaviors defined by Wetherby and Prizant (1989), which indicate communicative intent in children with autism.

Method

Participants

The PECS intervention group consisted of 24 children attending various special education classrooms or specialist units for autism across South Wales, within a maximum distance of 50 miles from the researchers’ base. The 50-mile limit was set as a viable distance for the researchers to travel to deliver teaching on a frequent basis. All of the children in this area who met the criteria for participation and who had parental consent and the co-operation of their school, were included in the intervention group. This complied with the ethical approval stipulation that every child for whom it was viable to deliver the intervention was included in the treatment group. The non-intervention control group consisted of children attending special education classrooms or units for autism outside the 50-mile limit. Selection of classrooms and units in the control group was prioritized according to their proximity to the research base. Seventeen children who met the criteria for participation were included on the basis of their availability to participate, parental consent and the agreement of their school to accommodate the researchers. Defining the experimental and control groups by territory and accepting all individuals as participants who met the inclusion criteria and for whom parental consent was obtained resulted in a design which, although not involving random assignment, still controlled against selection bias. The inclusion criteria, which were fulfilled by the participants in both groups, required that all children were aged between 3 and 7 years, had a previous diagnosis of autism from a clinical practitioner, which was verified through their classroom teachers from the child’s Statement of Special Educational Needs, and had received no previous PECS teaching beyond Phase I (the exchange of a single picture at close proximity). Of the children in the intervention group, only two had

received PECS teaching at Phase I. Their use of PECS was observed during the pre-intervention period and it was clarified that neither child had mastered Phase I as they were still being prompted heavily, either physically, verbally or gesturally, to hand over a picture in exchange for an item. None of the children in the control group received PECS teaching, either prior to their Time 1 observation or during the Time 1-to-Time 2 interobservation period. Table 1 specifies the mean chronological ages and age equivalents for Vineland Adaptive Behavior Scales (VABS) (Sparrow, Balla, & Cicchetti, 1985) and Preschool Language Scales—3 UK (PLS-3 UK) (Boucher & Lewis, 1997; Zimmerman, Steiner, & Pond, 1992) for the participants in the PECS intervention and control groups; there were no significant differences between the groups on measures of chronological age or on domain specific and composite measures for the VABS and PLS-3UK assessments.

Classroom Provision

The classroom provisions in the intervention and control groups reflected the current situation in the UK for educating children with autism apart from those students being included in mainstream classes. Teaching environments are either dedicated specialist units for autism or generic special needs classrooms for children with intellectual disabilities. The children in the intervention group were drawn from nine separate environments, six of which were specialist units for autism and three generic special needs classrooms. The children in the control group were drawn from 11 separate environments, seven of which were specialist units for autism and four generic special needs classrooms. Regardless of environment, the teaching approach for all children in the study was eclectic and none received any particular specialized approach to intervention. Each classroom in the intervention and control groups had a permanent teacher and two classroom aides. All teachers held the nationally recognized British graduate qualification in education. Student numbers in each classroom ranged between 6 and 8 children. Therefore the full-time staff:student ratios in all schools ranged between 1:2 and 1:2.66. Additional part-time staffing levels varied across schools.

Table 1 Group means for chronological age, Vineland ABS and PLS-3UK scores

	CA age in months	PLS-3UK age in months			Vineland ABS age in months		
		Rec.	Exp.	Comp.	Daily living	Social	Comp.
PECS group	5:5	7.8	7.4	7.7	16.5	12.0	14.7
Control group	5:9	8.6	9.8	9.4	15.9	12.5	14.8

Materials and Setting

Teaching Materials

Each child was equipped with a personal communication folder and accumulated a set of VelcroTM-backed colored pictures individualized to his/her range of preferred items and updated over the duration of the intervention period. Desirable items were identified for each child individually during direct observations and frequent, systematic preference checks. Desirable items included a range of novelty toys, classroom activities, food and drink. All teaching was conducted in the children's own school environment, either in a quiet area or in a regular classroom situation, depending on the requirements for the current teaching phase. Each child received a total of 15 h of PECS teaching; teaching was conducted during 3–4 PECS teaching days per week with a total of 1 h teaching delivered over 2–3 sessions on each PECS teaching day depending on the current teaching goal. These sessions sampled a range of situations that occurred during the child's regular classroom day, e.g., group activities, choice time, snack time, 1:1 teaching sessions. The total allocation of teaching hours was completed within a period of 4–5 weeks. Control group teachers verified that the control group children had received no additional intervention beyond their regular classroom provision during the period between T_1 and T_2 observations.

Observation Instrument

An observation instrument was designed to record the communicative interactions between the children and their classroom teachers and teaching assistants. This tracked each communicative event from its onset through to its conclusion and provided a running record of communication from two perspectives: (a) frequency and type of spontaneous child-to-adult communications with subsequent adult responses, (b) frequency and type of adult-to-child communications with subsequent child responses. Observations of children's initiations recorded both linguistic (i.e., speech, hand sign or graphic) and non-linguistic communications. Non-linguistic communications were defined in accordance with the guidelines from Wetherby and Prizant (1989). All the communicative behaviors were coded and operationally defined. Recordings permitted the analysis of five categories of communicative interaction, (1) total number of child-to-adult initiations, (2) number of child-to-adult initiations with a response from the adult, (3) total number of adult initiations

with opportunity for the child to respond, (4) number of adult initiations with opportunity for the child to respond and with a response from the child, (5) number of adult initiations with no opportunity for the child to respond. No opportunity to respond was defined as any communicative initiation by the adult, which was followed by physical guidance of the child's actions within 3 s. This denied the child the opportunity to attempt to respond independently to the communication. The observation instrument is illustrated in Appendix A and the operational definitions are presented in Appendix B.

Teaching

Two researchers were trained to deliver PECS teaching at a PECS workshop. The researchers administered a total of 15 h of PECS teaching up to Phase III to each child in the treatment group. The teaching objectives for Phases I, II and III defined by Frost and Bondy (2002) are described above. Phase I and Phase II teaching was delivered according to the PECS Training Manual instructions for all the children in the intervention group. The criterion for mastery of Phase I was unprompted exchange of a picture for an item across a table with the communication partner. The criterion for mastery of Phase II was unprompted execution of the following steps: locate the communication book, take the picture; travel across the room to the communication partner who had her back to the child; put the picture in the communication partner's hand. When Phase II was mastered with a range of items and with both researchers as communication partners, generalization of PECS use was extended into the classroom with teachers and teacher aides across each child's range of motivating activities (e.g., toy choice, snack-time, musical instrument sessions, book choice, puzzles, play-dough, etc.). For Phase III teaching, the children were allocated randomly, either to the procedure for discriminations teaching stipulated in the PECS manual or to a modified discriminations teaching procedure. The comparison between the manual-based and modified discrimination teaching procedures is a sub-study, which has been submitted separately (Carr & Felce, under review). All the children in the PECS treatment group received teaching in conditional discriminations with their six most highly preferred reinforcers, over a series of six individual sessions. Although the six most highly preferred reinforcers were selected for teaching discriminations, all the children were exchanging a wider range of pictures for other motivating items and activities by the time teaching was generalized into the classroom at the end

of Phase II. Therefore discrimination teaching was ongoing at T_2 and the range and accuracy of the children’s conditional discriminations varied across the intervention group. This is consistent with the PECS program, in which teaching at Phases II and III is ongoing as the child’s generalization of PECS use expands across items and activities. Therefore, for the purpose of scoring spontaneous communicative initiations using PECS at the T_2 observations, an independent initiation was scored whether or not the picture discrimination was accurate, providing that the child was unprompted in going to his/her book, taking a picture, and approaching and putting the picture in the teacher’s or the teacher aide’s hand. If correction was necessary, this was scored as an element of the teacher’s response to the child’s communication.

Design and Procedure

The study incorporated a within-subjects measure to control for the effects of maturation in participants in the PECS intervention group and a between-groups measure to measure the effects of intervention versus non-intervention in comparable groups of children. The measurement schedule is illustrated in Table 2.

PECS Group

Six weeks prior to commencement of teaching, the researchers conducted a 2-h observation (T_0) with each child in his/her classroom environment. The 2 h were divided into six, 20 min sessions over the day in order to sample communicative interactions between children and the members of their teaching teams over as wide a range of classroom situations as possible. These included free play, 1:1 educational sessions, snack-times and various group-based educational and directed play activities. A T_1 observation was conducted with each child according to the same criteria, during the week immediately preceding commencement of teaching. The period between T_0 and T_1 provided a 5-week maturation measure for the children in the PECS Group. Additionally, a Vineland Adaptive Behavior Scales (Classroom Edition) assessment and a Preschool Language Scales—3 (UK) assessment were

administered to each child during the T_1 week. Teaching commenced during the week immediately following T_1 observations and assessments and was conducted as described above, for each child. A T_2 observation was conducted with each child during the week immediately following completion of the 15 h teaching allocation. These observations provided a within-group measure of impact compared with maturation over a similar 5-week non-intervention period for maturation over a 5-week non-intervention period ($T_0 - T_1$) compared with a measure over a 4–5 week PECS intervention period ($T_1 - T_2$).

Control Group

T_1 and T_2 observations were conducted 6 weeks apart during a school half-semester, providing a clear 5-week interval between assessment points. As for the PECS group, the 2 h were divided into six 20 min sessions over the day. The $T_1 - T_2$ observations for the control group provided a measure over a 5-week non-intervention period, which could be directly compared with the $T_1 - T_2$ observations for the PECS intervention group over their 4–5 week intervention period. Additionally, a Vineland Adaptive Behavior Scale assessment and a Preschool Language Scale (Version 3-UK) assessment were administered to each child during T_1 week. Therefore the children in each group received the same pre-study assessments in the week immediately prior to the relevant intervention or non-intervention comparison period.

Reliability

Fifty-six percent of the total number of observation sessions were recorded by both researchers independently. Sessions were dual recorded as often as the time schedule permitted; time restriction was the only reason for a session being single rather than dual recorded. Reliability was analyzed under the following communication categories: Child-to-adult communicative initiations; adult-to-child communicative initiations with opportunity for child response; adult-to-child communicative initiations with no opportunity for child

Table 2 Within group and between groups observation and assessment schedule

Group			Time	
			T_1	T_2
PECS	2 h observation	No intervention	2 h observation VABS PLS-3UK	Intervention 2 h observation
Control			2 h observation VABS PLS-3UK	No intervention 2 h observation

response. Agreement between event recordings for each category was calculated using the formula:

$$\frac{\text{no. agreements}}{\text{no. agreements} + \text{no. disagreements}} \times 100.$$

An agreement was scored if the event was recorded and matched according to initiation and response information in both observations. A disagreement was scored if the event was not recorded in both observations or if there was a discrepancy between the observations concerning either the initiation or the response information. Inter-observer agreement was 89.78% (range 50–100%) for child-to-adult communicative initiations; 83.28% (range 52.7–100%) for adult-to-child communicative initiations with opportunity for child response; 90.14% (range 67–100%) for adult-to-child communications with no opportunity for child response.

Results

The means for all the observed communication measures are displayed in Table 3. Wilcoxon T tests were used to calculate significance levels for differences between within-subjects measures. Mann–Whitney U tests were used to calculate significance levels for differences in between-group measures.

Total Child-to-Adult Initiations

There was no significant difference in the total frequency of child-to-adult communicative initiations for the PECS group between T_0 and T_1 observations and there was no significant difference in the frequency between the PECS and Control groups at T_1 . The increase in frequency between T_1 and T_2 observations for the PECS group was significant, $T(24) = 0$, $P < .001$, but there was no significant difference for the Control group. The frequency of total child-to-adult

initiations was significantly higher for the PECS group than the Control group at T_2 ; $U(17,24) 404.5$; $z 5.30$, $P < .00003$.

Child-to-Adult Linguistic Communicative Initiations

There was no significant difference in the frequency of child-to-adult linguistic communicative initiations (words, signs or pictures/symbols) for the PECS group between T_0 and T_1 observations and there was no significant difference in the frequency between the PECS and Control groups at T_1 . The increase in frequency for the PECS group between T_1 and T_2 observations was significant, $T(24) = 0$, $P < .001$. The increase in linguistic communicative initiations at T_2 was accounted for almost entirely by PECS communications, where the mean for PECS initiations was 49.66 and the mean for other specific initiations was 1.13. There was no significant difference in frequency of linguistic communications for the Control group between T_1 and T_2 . The frequency of linguistic communications was significantly higher for the PECS group than the Control group at T_2 ; $U(17,24) 466$; $z 6.93$, $P < .00003$.

Child-to-Adult Initiations with Adult Response

There was no significant difference in the percentage of adult responses given to child-initiated communications for the PECS group between T_0 and T_1 and there was no significant difference between observations for the PECS and Control groups at T_1 . The increase for the PECS group between T_1 and T_2 was significant, $T(24) = 8$, $P < .005$. There was no significant difference for the Control group between T_1 and T_2 . The percentage of adult responses given to child-initiated communications was significantly higher for the PECS group than the Control group at T_2 ; $U(17,24) 258$, $z 2.80$, $P < .0026$.

Table 3 Table of means for PECS group T_0 , T_1 and T_2 observations and for control group T_1 and T_2 observations

Measures which were significantly different from the previous within-group observation are indicated with an asterisk (*)

Measure	Obs. time PECS group			Obs. time controls	
	T_0P	T_1P	T_2P	T_1C	T_2C
Child-to-adult total initiations	9.9	11.1	61.4*	12.6	10.0
Child-to-adult linguistic initiations in totals	0.4	0.7	50.8*	2.0	1.3
Child-to-adult initiations: % adult responses	76.3%	67.1%	96.7%*	78.35%	76.94%
Adult-to-child initiations with opportunity for child response	48.5	43.4	44.7	51.0	59.5*
Adult-to-child initiations with opportunity for child response: % child responses	53.3%	51.3%	66.8%	59.6%	58.4%
Adult-to-child initiations with no opportunity for child response	23.1	24.9	13.3*	18.9	21.1

Total Adult-to-Child Initiations with Opportunity for Child Response

There was no significant change in frequency of adult-to-child communicative initiations, which gave opportunity for child response for the PECS group between T_0 and T_1 . There was no significant difference between observations for the PECS and Control groups at T_1 . There was no significant increase in frequency for the PECS group between T_1 and T_2 but the increase in frequency for the Control group was significant; $T(17) = 35, P < 0.05$. There was no significant difference in frequency of initiations giving opportunity for child response between the PECS and Control groups at T_2 .

Adult-to-Child Initiations with Opportunity for Child Response Plus Response from Child

There was no significant difference in the percentage of child responses given to adult initiated communications for the PECS group between T_0 and T_1 ; there was no significant difference in the percentage of child responses to adult initiated communications between the PECS and Control groups at T_1 . The increase in percentage of child responses was significant for the PECS group between T_1 and T_2 , $T(23) = 62.5, P < 0.025$ but there was no significant change for the Control group. This resulted in a higher percentage of child responses to adult initiated communications for the PECS group at T_2 compared with the Control group at T_2 : $U(17,24) 291; z 2.3, P < .0107$.

Total Adult Initiations with No Opportunity for Child Response

There was no significant difference in the frequency of adult-to-child communicative initiations with no opportunity for child response for the PECS group between T_0 and T_1 ; there was no significant difference in the frequency between the PECS and Control groups at T_1 . The decrease in frequency for the PECS group between T_1 and T_2 was significant, $T(24) 12.5, P < .005$. The frequency of adult-to-child initiations with no opportunity to respond was significantly lower for the PECS group than the Control group at T_2 : $U(17,24) 141.5; z -1.65, P < .0495$.

Discussion

Observations of communicative interactions between children with autism and their classroom teaching staff identified a considerable increase in communicative

initiations by children who had received 15 h of PECS teaching at Phases I, II and III. Furthermore, the increase was accounted for almost entirely by PECS-based communications. Additionally, significant improvements in other measures of communicative interaction were evident for the PECS group. These included an increase in the percentage of child-initiated communications that received a response from an adult; a decrease in the number of communicative initiations by an adult, which provided no opportunity for the child to respond and an increase in the percentage of communicative initiations by an adult, which received a response from the child. These differences were not present in observations for the previous non-intervention period among the PECS intervention group, or in observations for a comparable non-intervention period with the control group. Control group observations identified a significant increase in the number of communicative initiations by an adult, which provided opportunity for the child to respond; this was not observed for the PECS group. However, the increase in the number of adult initiations was not accompanied by an increase in the percentage that received a response from the child.

These data indicate that the primary aim of PECS, to develop spontaneous communicative initiations in children with autism, was achieved within the first 15 h of focused PECS teaching for the children in the intervention group. The levels of achievement included persistence and spontaneity in the children's exchanges and generalization of use across objects, activities, environmental settings and people. It seems evident that including generalization of PECS use to classroom activities, objects and teachers during Phase II teaching played a critical role in securing the substantial increase in spontaneous initiations observed in T_2 observations. The researchers, who originally had taught the children to use PECS were no longer interacting with the children during T_2 observations. However, by that time the children had experienced high rates of reinforcement for using PECS with their teachers over a range of classroom activities. It seems probable that this would persist if the teachers continued to provide consistent reinforcement for the children's use of PECS.

As noted previously, the PECS program incorporates a comprehensive range of features consistent with principles recommended for developing spontaneous communicative initiations (e.g., Halle, 1984; Potter & Whittaker, 2001; Reichle et al., 1991; Yoder & Warren, 1993). However, the outcomes in this study were not limited to communicative initiations by the children. They also revealed significant improvements in the

dyadic patterns of communication between the children and the adults in their environment. These improvements were evident in increased responsiveness by adults and children to each other's communications and in a decreased tendency by adults to communicate with the children in a way that did not allow them sufficient opportunity to respond. The features of PECS, considered together with recommendations for communication development in aforementioned literature, permit some speculative analysis of the effect of PECS on these corollary outcomes.

Gaining the attention of a communicative partner has been highlighted as a vitally important prerequisite for effective communication (e.g., Halle, 1984; Reichle et al., 1991). It seems likely that teaching persistence in communicative approach immediately enhanced the teachers' attention to the children's communicative initiations, which previously were more tentative, less specific and not easily identifiable in the context of classroom "busyness". Furthermore, once attention was gained, the children were using clear, graphic representations to express their requests. The children's enhanced ability to gain attention, together with the clarity of their communications, would seem almost unquestionably to facilitate adults' "contingent responsivity" to the children's communications (e.g., Yoder & Warren, 1993). Consequently, this would be likely to have sustained the increased frequency of child-initiated communications as their effectiveness became increasingly evident to the children.

PECS teaching provides a clear structure of prompting and prompt fading. This is designed to avoid obstruction of spontaneous communication due to prompt dependence; eventually, communicative partners wait without prompting in order to encourage independent approaches from the child. The children reflected the success of this teaching strategy in increased spontaneous initiations. Furthermore teachers, as their communicative partners, were made aware of the benefits of not pre-empting the children's communications. This could have promoted a reduced tendency for teachers to pre-empt communications from the children both in initiative and in responsive contexts. Previous literature has highlighted the inhibiting effects on the dyadic process when the communicative attempts of children with language disabilities are pre-empted (e.g., Halle, 1984; Rogers-Warren & Warren, 1983). Therefore, it is possible that the reduction in pre-empting arose from the prompt limiting strategy in PECS.

Similar interpretations would be appropriate for the children's increased responsiveness to adult-initiated communications. The changes observed in the adults'

communicative patterns include increased responsiveness to child-initiated communications, decreased pre-emptive communication and increased opportunities for children to initiate communications across a range of natural situations. These changes naturally enhance the conditions of demand, expectation and opportunity, which have been highlighted as essential for promoting effective communication for children with language and communication disabilities (e.g., Halle, 1984; Potter & Whittaker, 2001; Yoder & Warren, 1993).

The outcomes in this study support the efficacy of PECS Phases I and II in establishing spontaneous communicative approaches in a social context for children with autism. Discrimination teaching at Phase III was incomplete regarding the range of items and activities involved in the children's use of PECS at T_2 observations. As noted previously, Phases I and II are the critical teaching phases for establishing independent, persistent and spontaneous communicative approaches, which were the focus of measurement in this paper. Therefore, inaccurate discriminations were still scored and the progress of that communication was recorded, provided that the child's approach was unprompted because nevertheless, a communication was initiated. This does raise the question of whether the outcome levels of child-initiated communications observed in this study would be maintained if errors persisted. In that eventuality, the teacher's response would include a correction procedure that delayed the child's access to the requested item. Therefore, the conclusions drawn on the basis of these data are that while PECS teaching up to Phase II is highly effective in establishing spontaneous communicative initiations in children with autism, it seems probable that the sustainability of this skill is at least partly dependent on the effective learning of an expanding picture-based vocabulary. Moreover, although it is evident that various other dimensions of communication between the children and adults in their environment were enhanced significantly, it is important to consider other aspects of the study, which could have made a contribution to the successful outcomes.

The two trainers, who had attended the 2-day PECS training workshop, were supernumerary to the regular staff presence in the children's classrooms for the 15 h duration of PECS teaching. Therefore, the PECS intervention group received additional input from more teacher resources compared with the control group, for this amount of time. Thus it should be acknowledged that this additional resource could have provided some advantage to the PECS group, which was not due directly to the PECS teaching methods. It is beyond the scope of this paper to assess how much of

an advantage this could have provided. However, considering that the PECS system has been constructed specifically around procedures for communication enhancement recommended in the wider literature, it seems likely that the procedures themselves provided the greater advantage in terms of the children's enhanced communicative interactions.

The involvement of the two additional trainers was necessary for the purposes of this investigation, in order to impose an acceptable level of treatment standardization across the multiple school settings that were visited throughout the study. This permitted an intensive focus on the PECS programme, which could be more difficult to organize when staff resources are more limited. However, there is evidence that this is achievable when the priority is given over to introducing the PECS milieu into the children's educational environment (e.g., Magiati & Howlin, 2003; Schwartz et al., 1998; Webb, 2000). In the current study, communication with PECS was transferred to teachers, once the children had mastered the exchange of a small range of single pictures with distance and persistence with the additional trainers. Although the time taken to achieve this level varied across the children, they all accomplished it within the first 6 h of PECS teaching. From that stage, the regular teaching staff were involved fully as the program focused on expanding the children's generalization of PECS use across a wide range of school-based activities.

Teaching for generalization was embedded in the children's most highly motivating activities, which were available regularly within their school curricula. Therefore it was not necessary to introduce a range of new activities in order to support the PECS program but only to rearrange the teaching protocols for existing activities to promote the children's use of PECS. Some teachers expressed concern that the children's less preferred activities might have been neglected as priority was given to the most motivating activities. For example, pre-intervention observations may have recorded one-to-one teacher-and-child interactions while a child was completing an inset jigsaw puzzle with teacher instruction. Subsequently, a reinforcer assessment may have revealed that using dough and cutters was a considerably more motivating activity than doing jigsaws. Therefore the dough activity would have been made available more frequently than jigsaws for this child; for another child, the reverse might have been true. The final observations inevitably reflect a difference in the range of activities observed because embedding communication teaching in motivating activities is a central feature of the PECS milieu, which is consistent with principles of incidental teaching

(Charlop et al., 1985; Koegel et al., 1987, 1998; Laski et al., 1988; McGee et al., 1985, 1992). Capitalizing on motivation has been advocated widely as a necessity for successful communication training in literature on best practice for children with autism (e.g., Halle, 1984; Potter & Whittaker, 2001; Yoder & Warren, 1993). Therefore, focusing on motivating activities can be justified as a facilitating, rather than a limiting strategy for teaching communication.

The presence of the researchers during T_2 observations cannot be disregarded as a probable contributor to the substantial increase of PECS-related communications. The teachers were aware of the observations and furthermore, previously had been practicing use of PECS with the children in the classroom during Phase II teaching. Therefore it is very likely that the teachers were aiming for optimum outcomes for PECS use during the T_2 observation periods by presenting and responding to as many communication opportunities as possible. This level probably would not be sustained in the longer term unless the primary focus remained on maintaining and expanding the children's use of PECS in the classroom. The variables accounting for maintenance and expansion of PECS use once it has been established is an important issue, which has yet to be addressed in research and which was not the focus of the current study.

It is less likely that the researchers' presence influenced the teachers' or the children's additional corollary communicative behaviors at T_2 . These include increased child responsiveness to adult initiations and decreased adult initiations with no opportunity for child response. These behaviors already had been observed at T_0 and at T_1 and the observation measures for that interval confirm that they remained constant. This suggests that these behaviors were not affected by demand characteristics in the previous observations. Furthermore, topographically these behaviors were not PECS-related, so as the focus of the study was on use of PECS, neither does it seem likely that they would have been affected by demand characteristics in the T_2 observations.

The outcomes of this study indicate that under optimum conditions of delivery, the first half of the PECS program emerges as a highly effective augmentative communication tool for promoting a range of communicative functions, including initiation and responsivity in children with autism and increased opportunity and responsivity from the adults with whom they interact. If such gains are to be present in the educational settings of children with autism, it is essential that their teachers have access to adequate training to deliver PECS teaching effectively. Moreover, in view of the current evidence for the children's increased levels of attention and responsivity to the

Appendix B

Observation Definitions

<u>Child</u>		<u>Adult</u>	
V	Vocalise: Any discrete/ non-continuous vocalisation while looking towards an adult	V	Vocalise: Any verbal comment directed specifically at a child and unaccompanied by any other action
P	Protest: Initiation: reaction to a non-social event including crying, shouting, pulling away, pushing away, throwing Response: reaction to communication or social engagement including crying, shouting, pulling away, pushing away, throwing.		
A	Approach: Movement towards individual to within 3 steps	A	Approach: Movement towards individual to within 3 steps
AV	Approach + Vocalise: Movement towards individual to within 3 steps and simultaneous vocalisation	AV	Approach + Vocalise: As child AV
T	Touch: Deliberate touch with hand	T	Touch: As child T
AW	Approach/Withdraw: Approaches to within 3 steps then withdraws		
AP	Approach + Protest: As AV but vocalisations crying/shouting		
AI	Approach + Indicate: Approach to 3 steps + point or gesture	AI	Approach + Indicate: As child AI
AL	Approach + Lead: Take hand or clothes and guide to event	AL	Approach + Lead: Approach and physically guide child through event (dressing, movemet, feeding, toilet, etc.)
Att	Attend: Turn head towards or make eye contact with initiating communicator	Att	Attend: Turn head towards or make eye contact with initiating child
		Int	Interpret: After attending, attempt to guess the meaning of the communication
Res	Respond: After attending, acting on communicator’s initiation (accuracy not required)	Res	Respond: After interpreting child initiation, making non-specific verbal or physical response
Pro	Provide: Responding by specific co-operation with communicator’s request or instruction	Pro	Provide: Delivery of interpreted request from child
W	Withdraw: Child moves away from communicator /no other response		
C	Comply: Passive co-operation with communicator (allowing dressing, feeding, movement without protest)		
Wd	Word: Uses specific word to communicate		
S	Sign: Uses recognised sign to communicate		
PS	Picture/symbol: Communicates by pointing to or offering a picture or symbol as request or comment		

teachers, teachers should be supported in their prioritizing of communication teaching as the primary route for access to all areas of the curriculum.

Acknowledgment This study was funded through a grant provided by the Healthcare Foundation (formerly PPP Foundation).

References

- Bondy, A. S., & Frost, L. A. (1994a). The Delaware autistic program. In S. Harris, & J. Handleman (Eds.), *Preschool education programs for children with autism* (pp. 37–54). Austin, TX: Pro-Ed.
- Bondy, A. S., & Frost, L. A. (1994b). The picture exchange communication system. *Focus on Autistic Behavior*, 9, 1–19.
- Bondy, A. S., & Frost, L. A. (1998). The picture exchange communication system. *Seminars in Speech and Language*, 19, 373–389.
- Boucher, J., & Lewis, V. (1997). *Preschool language scale-3(UK)*. San Antonio: The Psychological Corporation, Harcourt, Brace & Co.
- Carr, E. G., & Kologinsky, E. (1983). Acquisition of sign language by autistic children. II: Spontaneity and generalization effects. *Journal of Applied Behavior Analysis*, 16, 111–126.
- Charlop, M. H., & Haymes, L. K. (1994). Speech and language acquisition and intervention: Behavioral approaches. In J. L. Matson (Ed.), *Autism in children and adults: Etiology, assessment and intervention* (pp. 213–240). Pacific Grove, CA: Brooks/Cole.
- Charlop, M. H., & Trasowech, J. E. (1991). Increasing autistic children's daily spontaneous speech. *Journal of Applied Behavior Analysis*, 24, 747–761.
- Charlop, M. H., & Walsh, M. (1986). Increasing autistic children's spontaneous verbalizations of affection through time delay and modelling procedures. *Journal of Applied Behavior Analysis*, 19, 307–314.
- Charlop, M. H., Schreibman, L., & Thibodeau, M. G. (1985). Increasing spontaneous verbal responding in autistic children using a time delay procedure. *Journal of Applied Behavior Analysis*, 18, 155–166.
- Charlop-Christie, M. H., Carpenter, M., Le, L., LeBlanc, L. A., & Kellet, K. (2002). Using the picture exchange communication system (PECS) with children with autism: Assessment of PECS acquisition, speech, social communicative behavior, and problem behavior. *Journal of Applied Behavior Analysis*, 35, 213–231.
- Frost, L. A., & Bondy, A. S. (1994). *PECS: The picture exchange communication system training manual*. Cherry Hill, NJ: Pyramid educational Consultants, Inc.
- Frost, L. A., & Bondy, A. S. (2002). *PECS: The picture exchange communication system training manual* (2nd ed.). Newark, DE: Pyramid Educational Products Inc.
- Goldstein, H. (2002). Communication intervention for children with autism: A review of treatment efficacy. *Journal of Autism and Developmental Disorders*, 32, 373–395.
- Halle, J. W. (1984). Arranging the natural environment to occasion language: Giving severely language-delayed children reasons to communicate. *Seminars in Speech and Language*, 3, 185–197.
- Halle, J. W., Marshall, A. M., & Spradlin, J. E. (1979). Time delay: A technique to increase language use and facilitate generalization in retarded children. *Journal of Applied Behavior Analysis*, 12, 431–439.
- Hart, B., & Risley, T. R. (1980). In vivo language intervention. Unanticipated general effects. *Journal of Applied Behavior Analysis*, 13, 407–432.
- Koegel, R. L., Camarata, S., Koegel, L. K., Ben-Tall, A., & Smith, A. E. (1998). Increasing speech intelligibility in children with autism. *Journal of Autism and Developmental Disorders*, 28, 241–251.
- Koegel, R. L., Koegel, L. K., & Schreibman, L. (1991). Assessing and training parents in teaching pivotal behaviors. In R. J. Prinz (Ed.), *Advances in behavioral assessment of children and families*, Vol. 5 (pp. 65–82). London: Jessica Kingsley.
- Koegel, R. L., O'Dell, M. C., & Koegel, L. K. (1987). A natural language teaching paradigm for nonverbal autistic children. *Journal of Autism and Developmental Disorders*, 18, 525–538.
- Kraijer, D. (1997). *Autism and autistic like conditions in mental retardation*. Lisse NL: Swets & Zeitlinger.
- Laski, K., Charlop, M., & Schreibman, L. (1988). Training parents to use the natural language paradigm to increase their autistic children's speech. *Journal of Applied Behavior Analysis*, 21, 391–400.
- Lord, C., & Paul, R. (1997). Language and communication in autism. In D. Cohen & F. Volkmar (Eds.), *Handbook of autism and developmental disorders* (2nd ed.) (pp. 195–225). New York: Wiley.
- Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology*, 55, 3–9.
- Magiati, I., & Howlin, P. (2003). A pilot evaluation study of the picture exchange communication system (PECS) for children with autistic spectrum disorders. *Autism*, 7, 297–320.
- McGee, G. G., Almeida, M. C., Sulzer-Azaroff, B., & Feldman, R. S. (1992). Promoting reciprocal interactions via peer incidental teaching. *Journal of Applied Behavior Analysis*, 25, 117–126.
- McGee, G. G., Kranz, P. J., & McClannahan, L. E. (1985). The facilitative effects of incidental teaching on preposition use by autistic children. *Journal of Applied Behavior Analysis*, 18, 17–31.
- Potter C., & Whittaker, C. (2001). *Enabling communication in children with autism*. London and Philadelphia: Jessica Kingsley.
- Prizant, B. M., & Wetherby, A. M. (1987). Communicative intent: A framework for understanding social communicative behavior in autism. *Journal of the American Academy of Child and Adolescent Psychiatry*, 26, 472–479.
- Reichle, J. Sigafos, J., & Remington, R. E. (1991). Beginning an augmentative communication system with individuals who have severe disabilities. In R. E. Remington (Ed.), *The challenge of severe mental handicap* (pp. 189–213). Chichester: Wiley.
- Remington, R. E. (1998). Working with people with communication difficulties. In E. Emerson, C. Hatton, J. Bromley, & A. Caine (Eds.), *Clinical psychology and people with intellectual disabilities* (pp. 231–244). Chichester: Wiley.
- Rogers-Warren, A. K., & Warren, S. F. (1983). Facilitating early language and social development: parents as teachers. In E. M. Goetz, & K. F. Allen (Eds.), *Early childhood education: Special environmental and legal considerations*. Rockville, MD: Aspen Systems.
- Sallows, G., Graupner, G. (2001). Replicating Lovaas: Results after three years. Presented at the 27th Annual Convention of the Association for Behavior Analysis, New Orleans, LA.

- Schuler, A. L., Prizant, B. M., & Wetherby, A. M. (1997). Enhancing language and communication development: Prelinguistic approaches. In D. J. Cohen, F. R. Volkmar (Eds.), *Handbook of autism and pervasive developmental disorders* (2nd ed.). New York: Wiley.
- Schwartz, I. S., Garfinkle, A. N., & Bauer, J. (1998). 'The picture exchange communication system: Communicative outcomes for young children with disabilities. *Topics in Early Childhood Special Education, 18*, 144–159.
- Smith, T., Eikeseth, S., Klevstrand, M., Lovaas, O. I. (1997). Intensive behavioral treatment for preschoolers with severe mental retardation and pervasive developmental disorder. *American Journal on Mental Retardation, 102*, 238–249.
- Sparrow, S. S., Balla, D. A., & Cicchetti, D. (1985). *Vineland adaptive behavior scales (Classroom Ed.)*. MN: American Guidance Service, Inc.
- Stokes, T. F., & Baer, D. M. (1978). An implicit technology of generalization. *Journal of Applied Behavior Analysis, 10*, 349–367.
- Van der Gaag, A, & Dormandy, L. (1993) *Communication and adults with learning disabilities*. London: Whurr Publishers.
- Webb, T. (2000). Can children with autism and severe learning difficulties be taught to communicate spontaneously and effectively using the picture exchange communication system? *Good Autism Practice, 1*, 29–42.
- Weitz, C., Dexter, M., & Moore, J. (1997). AAC and children with developmental disabilities. In S. Glenned, & D. Decoste (Eds.), *Handbook of augmentative and alternative communication* (pp. 395–431). San Diego, CA: Crocus.
- Wetherby, A. M., & Prizant, B. M. (1989). The expression of communicative intent: Assessment guidelines. *Seminars in Speech and Language, 10*, 77–91.
- Wetherby, A. M., & Prutting, C. (1984). Profiles of communicative and cognitive-social abilities in autistic children. *Journal of Speech and Hearing Research, 27*, 364–377.
- Yoder, P. J., & Warren, S. F. (1993). Can developmentally delayed children's language development be enhanced through prelinguistic intervention? In A. P. Kaiser, & D. B. Gray (Eds.), *Enhancing children's communication: Foundations for intervention* (pp. 35–61). Baltimore, MD: Brookes.
- Zimmerman, I. L., Steiner, V. G., & Pond, R. E. (1992). *Preschool language scale-3*. San Antonio: The Psychological Corporation, Harcourt, Bruce & Co.