

# Effectiveness of the Picture Exchange Communication System as a Functional Communication Intervention for Individuals with Autism Spectrum Disorders: A Practice-Based Research Synthesis

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*Abstract: This research synthesis verifies the effectiveness of the Picture Exchange Communication System (PECS) for improving the functional communication skills of individuals with autism spectrum disorders (ASD). The research synthesis was focused on the degree to which variations in PECS training are associated with variations in functional communication outcomes (Dunst, Trivette & Cutspec, 2002). The communication consequences of PECS were examined in 13 studies, which included 125 participants with ASD who had been identified as having limited or no functional communication skills. Claims that PECS is an effective intervention for improving functional communication skills appeared to be supported by the available research evidence.*

The purpose of this practice-based research synthesis was to verify the effectiveness of the Picture Exchange Communication System (PECS) for improving the functional communication skills of individuals with autism spectrum disorders (ASD). The synthesis focused on the degree to which variations in the PECS training are associated with variations in functional communication consequences. In general terms, a practice-based research synthesis differs from more traditional meta-analyses by systematically examining and unpacking the characteristics of practices that are related to differences in outcomes or consequences. Specifically, this type of analysis focuses more on understanding how the same or similar characteristics exert the same or similar observable effects and not solely on statistical or observation-based relationships between or among these variables. The reader is referred to Dunst et al. (2002) for a detailed explanation of this framework.

Individuals diagnosed with ASD share significant deficits in communication (American

Psychiatric Association, 2000). In order to address the communication challenges of children with ASD, behavior analysts, speech-language pathologists, and special educators increasingly have turned to augmentative and alternative communication (AAC) (Frea, Arnold, & Vittimberga, 2001). The Picture Exchange Communication System (PECS) is one of such augmentative communication system designed to increase functional communication skills and potentially provide a bridge to speech acquisition.

The Picture Exchange Communication System been supported by a small number of case studies and a large body of anecdotal literature (Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Magiati & Howlin 2003; Mirenda, 2001; Mirenda & Erickson, 2000). Thus few published experimental studies have specifically investigated the effectiveness of PECS for children with ASD or other developmental disabilities. Furthermore, the majority of the anecdotal literatures reviewing the effectiveness of PECS were contributed by its developers, Andy Bondy and Lori Frost.

Bondy and Frost's first published article (1993) on PECS detailed its use with children and adults with developmental disabilities. Specifically, they described the procedures

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used to train school-based staff in Peru to use the system over a five-month period. Although no formal data were collected, the school reported that of the 74 students who received the PECS training, at the end of a 3-month period, 28 were working on mastering Phase I, 28 were working on mastering Phases II, and 18 were working on mastering Phase III of the PECS training protocol.

In another study, Bondy and Frost (1994) reported outcomes for 85 noncommunicative preschool children with ASD aged 5 years or younger. While children's cognitive abilities were not assessed, they were estimated as ranging from near-normal to profoundly disabled. Over 95% learned to use two or more pictures within the exchange format; almost all learned at least one picture within one month of starting the PECS. For the 66 children who used PECS for more than a year, 41 were able to use speech independently, whereas the remaining 25 children were using a combination of pictures or symbols and speech. All children mastered using pictures or symbols to communicate, although not all reached the highest levels of PECS. Bondy and Frost (1994) also presented anecdotal data from a number of single-case and small-group studies. Most indicated encouraging results in terms of increased spontaneous communication and speech and, in some case, decreased behavioral problems.

The impact of PECS on problem behaviors was also examined in several studies beyond that of Bondy and Frost. For example, PECS was reported as an effective intervention for a 4-year-old with autism to decrease aggressive behavior in a general education preschool classroom (Frea et al., 2001). Dooley, Wilczen-ski, and Torem (2001) reported a dramatic decrease in problem behaviors and increase in compliance during transitions following PECS on a 3-year-old boy with a diagnosis of pervasive developmental disorders (PDD).

#### *Description of PECS Practice*

Developed in 1985 by Andrew Bondy and Lori Frost, PECS originally was primarily used for preschool-age children with ASD and other social communicative disorders who displayed no functional or socially acceptable speech (Frost & Bondy, 2002, pp. 46). The rationale

behind PECS is that the exchange of a picture for a reinforcing item parallels the communicative exchange that takes place in typical conversation (Bondy & Frost, 1993, 1994). The PECS training is based on research and practice in the principles of applied behavior analysis. Thus, distinct teaching strategies, reinforcement strategies, error correction strategies and generalization strategies are essential for teaching each skill (see Frost & Bondy, pp. 46-47).

PECS is different from other communication systems in three main ways: (a) it does not require prerequisite skills; (b) it was designed to address the lack of motivation for social reinforcement; and (c) it immediately teaches initiating, instead of teaching responding before initiating (Bondy & Frost, 1994). The PECS training consists of six phases, which will be described in detail in the following.

*Phase I—"How" to Communicate.* In this phase, the terminal objective is that upon seeing a "highly preferred" item, the child will pick up a picture of the item, reach toward the communicative partner, and release the picture into the trainer's hand (Frost & Bondy, 2002, pp. 67). One trainer entices the child with an object that is highly desired. As the child reaches for the desired object, the second trainer, the facilitator, physically assists the child in picking up a picture for the desired object. The first trainer immediately gives the child a reward along with an appropriate comment, such as "Oh, you want M&M!" when he/she receives the picture.

*Phase II – Distance and Persistence.* In this stage, the exchange continues with attempts to increase the child's independence. Thus, the terminal objective is that the child goes to his communication book where his picture is stored, pulls the picture off, goes to the trainer, gets the trainer's attention, and releases the picture into the trainer's hand (Frost & Bondy, 2002, pp. 93). The child now is encouraged to use greater spontaneity and persistence, and to generalize the skill he acquired. The facilitator is still available for as-needed assistance. Thus, the child learns to remove the picture from a display board for the exchange and must engage in more physical movement than in Phase I in order to accomplish the exchange. However, the child

is still encountering only one symbol on a board at any one time.

*Phase III – Picture Discrimination.* The terminal object for this phase is that the child requests desired items by going to a communication book, selecting the appropriate pictures from an array, and going to a communication partner and giving him/her the picture (Frost & Bondy, 2002, pp.123). In this stage the child is asked to discriminate between several items on a board, choosing which item he wants, or which activities he wants to try. The child begins by answering forms of the question “What do you want?” but these are faded quickly so the child will make choices spontaneously as well as in response to a question. As the child becomes more comfortable making discriminations, a third item may be added, and so on.

*Phase IV – Sentence Structure.* The terminal objective is that the child requests present and non-present items using a multi-word phrase by going to the book, picking up a picture/symbol of “I want,” putting it on a sentence strip, picking out the picture of what she wants, putting it on the sentence strip, removing the strip from the communication board, and finally approaching the communicative partner and giving the sentence strip to him (Frost & Bondy, 2002, pp.159). Thus, the child is taught to combine the object picture with the carrier phrase “I want” on a sentence strip and to give the strip to the adult or communication partner. The two pictures are attached to a sentence strip and the entire strip is exchanged with the communicative partner in return for the pictured item.

*Phase V – Responding to “What do you want?”* In this stage the child learns to respond to the question “What do you want?” by exchanging the sentence strip. Thus, this phase extends the sentence structure begun in Phase IV. Use of the questioning phrase is deliberately delayed until this phase because the exchange behavior should be automatic by that point in the programming sequence (Frost & Bondy, 2002, pp. 209). Adjectives and other words may be added to the child’s repertoire to help her further refine her requests.

*Phase VI – Commenting.* In this final stage, the child learns to respond to the questions “What do you want?” “What do you see?” “What do you have?” This phase makes a fun-

damental shift in the child’s communication as well as the expected outcome from the teachers or peers. That is, it is designed to introduce the child to commenting behavior, while the previous stages focused on requesting behavior. Through the use of pictures for “I see,” “I hear,” “I smell,” etc., the child is taught to comment on elements of his/her environment.

## Search Strategy

### *Search Terms*

Relevant studies were identified by using the keywords “PECS” and “Picture Exchange Communication System.” The term “autism” was used to further restrict the search. Further, an author search was conducted using “Andy Bondy” and “Lori Frost.”

### *Sources*

A computer-assisted bibliographic search was conducted. The Psychological Abstracts (PsycINFO), Educational Resources Information Center (ERIC) database, Expanded Academic ASAP, Wilson OmniFile, MEDLINE, Dissertation Abstract Online, Center for International Rehabilitation Research Information and Exchange (CIRRIE), and REHABDATA were the primary information databases searched for relevant studies. An online search of the Internet via the Google search engine was also conducted. The reference lists of all acquired sources were also reviewed. In addition, hand searches were completed for journal articles, book chapters, and books to locate additional studies of PECS that may have been omitted from the bibliographic search findings. Finally, repeated sweeps of various sources were made until no further studies could be located.

### *Selection Criteria*

Studies were included in the research synthesis if they met all the following criteria: (a) the focus of the study was to establish the effectiveness of PECS for improving functional communication skills; (b) the PECS training was described in sufficient detail to ascertain that the intervention applied in a review study

was the same as the intervention described under Description of the Practice; (c) individuals involved in the study were diagnosed with ASD; (d) communication consequences were the major outcome measured; and (e) articles were written in English.

*Exclusion criteria.* It was necessary to exclude on study (Cummings & Williams, 2000) that appeared to have met all the inclusion criteria during the initial phase of the search process. Close inspection of the study revealed that the PECS training was only one component of the treatment so as to warrant its exclusion.

### *Search Results*

Eleven articles, including 13 studies and 125 participants, met the selection criteria and were included in the research synthesis. Table 1 shows selected characteristics of the participants. Table 2 lists the research designs used in the studies, dependent measures, and the characteristics of the intervention.

### *Participants*

The 125 participants who participated in the studies all exhibited limited or no functional communication skills (see Table 1). Ages ranged from one to twelve years old at the baseline assessment. Participants' gender was reported in 10 of the studies (77%). The vast majority (65%) of the participants were reported as males (female = 36, male = 68). Across all the studies, participants' ethnicity was only reported in three studies (Charlop-Christy et al., 2002; Ganz & Simpson, 2004; Tincani, 2004).

Participants' language age was reported in five studies (36%); however, different methods were used for assessment and reporting. Eight studies (57%) did not report participants' language age, but provided descriptions of their speech abilities (Adkins & Axelrod, 2002; Ganz & Simpson, 2004; Heneker & Page, 2003; Liddle, 2001; Schwartz, Garfinkle, & Bauer, 1998; Tincani, 2004). In the two studies (Charlop-Christy et al., 2002; Jones, 2005) that specifically reported expressive and receptive language ages, the participants' expressive language ages ranged from 1.2 to 1.8 years, with a mean age of 1.4; the participants'

receptive language ages ranged from 1.8 to 1.9 years, with a mean age of 1.9 years.

Participants' developmental age was reported in three studies (Anderson, 2002; Ganz & Simpson, 2004; Kravits, Kamps, Kemmerer, & Potucek, 2002), but different methods were used for assessment and reporting. One study (Tincani, 2004) reported participants' standardized intelligence scores on the Developmental Profile-II. Nine studies (64%) did not report any IQ, developmental ages, or other related information on participants; however, one study (Schwartz et al., 1998) indicated that the participants were identified as having cognitive delays.

### *Research Designs*

Table 2 summarizes the research design employed by the studies included in this synthesis. Twelve studies (92%) used single-participant designs. One study used a retrospective analysis of archival data to examine pre-/post-intervention outcomes (Schwartz et al., 1998).

Among the 12 studies employing single-participant designs, four types of research designs were employed. First of all, an AB or a variation of the design was used in four studies (Ganz & Simpson, 2004; Heneker & Page, 2003; Magiati & Howlin, 2003). Second, two studies employed multiple-baseline design across participants (Charlop-Christy et al., 2002; Jones, 2005) while one study used multiple-baseline designed across settings (Kravits et al., 2002). Third, two studies used a changing-criterion design to eliminate the need to withdraw the intervention and include several interventions subphases (Ganz & Simpson; Liddle, 2001). Last, an alternating-treatments design was employed in three studies comparing the effectiveness of PECS and sign language training (Adkins & Axelrod, 2002; Anderson, 2002; Tincani, 2004).

Three of the 12 single-participant studies (25%) reported follow-up data after post treatment (Charlop-Christy et al., 2002; Jones, 2005; Schwartz et al., 1998). Length of time between post-treatment and follow-up ranged from 1 month to 12 months. Two studies conducted by Heneker and Page (2003) reported follow-up results but did not provide data.

In addition, all 12 single-participant studies employed outcome measures that require ob-

**TABLE 1**

**Characteristic of Participants**

Study	Gender			Ethnicity	Chronological Age (years:months)	Language Age (years:months)/ Other Info.	Developmental Age/IQ/ Other Info.	Diagnosis
	N <sup>a</sup>	M	F					
Adkins & Axelrod (2002)	1	1	0	N/A*	7	No functional language	N/A	PDD <sup>b</sup> and ADHD <sup>c</sup>
Anderson (2002)	6	4	2	N/A	2-4	0:8-1:6 (CDI <sup>d</sup> Production) 0:8-1:4 (CDI Comprehension)	1:3-1:7 Years (Bayley)	a. Autism b. PDD
Charlop-Christy et al. (2002)	3	3	0	a. Ethiopian-American b. Chinese-American c. Korean-American	3:8-12	1:2 (MCDI <sup>e</sup> Expressive) 1:9 (PPVT <sup>f</sup> Receptive) 0:10-1:6 (VABS <sup>g</sup> Communication Domain)	N/A	Autism
Ganz & Simpson (2004)	3	2	1	a. Asian b. African-American c. Caucasian	3:9-7:2	No functional language	0:7 Years (VABS) for 1 child. 2:4 Years (Battelle) for 1 child. N/A for 1 child	a. Autism b. Developmental delay with autistic characteristics c. Developmental delay and speech/language impairment
Heneker & Page (2003)	N/A	N/A	N/A	N/A	1-3	No functional language	N/A	Autism
	N/A	N/A	N/A	N/A	4-5	Limited functional language	N/A	Autism
Jones (2005)	5	3	2	N/A	5:1-8:2	0:10-1:10 (VABS Adaptive Communication) 1:9-1:11 (PPVT Receptive) 1:4-1:10 (PLS <sup>h</sup> Expressive)	N/A	Autism
Kravits et al. (2002)	1	0	1	N/A	6	27% rank (WPPSI-R <sup>i</sup> Verbal Behavior)	2:8 Years (VABS) 2-2.5 Years (PEP-R <sup>j</sup> )	Autism
Liddle (2001)	21	N/A	N/A	N/A	N/A	Limited or no functional language	N/A	a. Autism b. Severe learning disabilities
Magiati & Howlin (2003)	34	29	5	N/A	5-10:6	0:8-2:8 (VABS Communication Domain)	N/A	Autism
	31	22	9	N/A	3-6	Limited or no functional communication skills	Cognitive delay	a. Autism b. PDD-NOS <sup>k</sup> c. Other developmental disabilities
Schwartz et al. (1998)	18	3	15	N/A	3:3-5:11	Nonverbal	N/A	a. Autism b. Other developmental disabilities

TABLE 1—(Continued)

Study	N <sup>a</sup>	Gender		Ethnicity	Chronological Age (years:months)	Language Age (years:months)/ Other Info.	Developmental Age/IQ/ Other Info.	Diagnosis
		M	F					
Tincani (2004)	2	1	1	a. African-American b. Asian-American	5:10–6:8	No functional language	54IQ (Developmental ProfileII) for 1child, N/Afor 1child	Autism
Total	125	68	36		1–12			

- <sup>a</sup> Number of participants.
- <sup>b</sup> Pervasive developmental disorder.
- <sup>c</sup> Attention deficit hyperactivity disorder.
- <sup>d</sup> MacArthur Communicative Development Inventory.
- <sup>e</sup> Minnesota Child developmental Inventory.
- <sup>f</sup> Peabody Picture Vocabulary Test.
- <sup>g</sup> Vineland Adaptive Behavior Scales.
- <sup>h</sup> Preschool Language Scale.
- <sup>i</sup> Wechsler Preschool and Primary Scale of Intelligence.
- <sup>j</sup> Psychoeducational Profile-Revised.
- <sup>k</sup> Pervasive developmental disorder-not otherwise specified.
- \* N/A = Information not available in the article.

servational coding. Interrater reliability data were only presented in eight of the studies (67%), 5 studies (Adkins & Axelrod, 2002; Heneker & Page, 2003; Liddle, 2001; Magiati & Howlin, 2003) did not report reliability data.

*Characteristics of Application of PECS*

PECS was delivered in a variety of natural settings, such as homes and schools, across the 13 studies. With two exceptions, intervention agents were reported (85%). PECS was implemented specifically by experimenters or trained personnel in three studies (Adkins & Axelrod, 2002; Charlop-Christy et al., 2002; Ganz & Simpson, 2004), while the remaining eight studies utilized teachers or parents as the intervention deliverers.

Selected characteristics of the PECS intervention implemented in each study are also presented in Table 2. As illustrated, nine studies indicated how many phases of the PECS training were conducted; the remaining studies did not (Adkins & Axelrod, 2002; Heneker & Page, 2003; Schwartz et al., 1998). In five of the studies that indicated PECS phases, the participants received the entire six phases of the PECS training. The remaining four studies (Anderson, 2002; Ganz & Simpson, 2004; Kravits et al., 2002;

Tincani, 2004) reported that the participants received three or four phases of the training.

*Treatment fidelity.* Information regarding the fidelity of treatment implementation was reported in all the studies. However, fidelity data were only reported in three studies; the remaining studies (77%) just stated that the treatment was implemented according to the procedures described in *The Picture Exchange Communication System Training Manual* (Adkins & Axelrod, 2002; Charlop-Christy et al., 2002; Ganz & Simpson, 2004; Kravits et al., 2002; Schwartz et al., 1998) or that the implementers were formally trained to use PECS (Heneker & Page, 2003; Liddle, 2001; Magiati & Howlin, 2003). In the three studies that reported fidelity data, two independent observers coded sessions or session videotapes to establish the implements' degree of adherence to the treatment manual content (Anderson, 2002; Jones, 2005; Tincani, 2004). For those three studies, the mean interobserver agreement for treatment fidelity was 93.86% (range from 91.675 to 96.8%).

**Outcomes**

Participants' communication outcomes were measured in all the studies using a range of data collection methods and a range of re-

**TABLE 2**

**Characteristics of the Research Designs and Interventions**

<i>Study</i>	<i>Research Design<sup>a</sup></i>	<i>Dependent Measures</i>	<i>Natural Intervention Setting</i>	<i>Intervention Agent</i>	<i>PECS Phase</i>	<i>Average Length of Follow-up</i>	<i>Fidelity<sup>b</sup></i>	<i>Reliability</i>
Adkins & Axelrod (2002)	(S) Alternative treatments	a. Correct responses b. Mastery rate c. Most preferred responding technique	Y	Experimenters	N/A*	N/A	M	N/A
Anderson (2002)	(S) Alternative treatments	a. Correct responses b. Mastery rate c. Frequency of initiation d. Behavior e. Eye contact f. Vocalization.	N	N/A	I-III	N/A	M, O	Y
Charlop-Christy et al. (2002)	(S) Multiple baseline	a. Spoken language b. Social-communicative behavior c. Problem behavior	Y	Therapists	I-VI	10 months	M	Y
Ganz & Simpson (2004)	(S) Changing criterion	a. PECS acquisition b. Intelligible words c. Non-word vocalization	Y	Experimenters	I-IV	N/A	M	Y
Heneker & Page (2003)	(S) O <sub>1</sub> XO <sub>2</sub> O <sub>3</sub>	a. Amount of communication b. Function of communication c. Methods of communication d. Level of adult support	Y	Teachers	N/A	10 months	C	N/A
	(S) O <sub>1</sub> XO <sub>2</sub> O <sub>3</sub>	a. Amount of communication b. Function of communication c. Methods of communication d. Level of adult support	Y	Teachers	N/A	6 months	C	N/A
Jones (2005)	(S) Multiple baseline	a. Spontaneous requests b. Time delay c. Generalization	Y	N/A	I-VI	1 month	C, O	Y
Kravits et al. (2002)	(S) Multiple baseline	The frequency of spontaneous language	Y	Teachers Mother	I-III	N/A	M	Y
Liddle (2001)	(S) Changing criterion	PECS acquisition	Y	Teachers Speech and language therapist	I-VI	N/A	C	N/A

spondents. The majority of communication outcomes were measured through two individual observation reports or through observa-

tional coding of sessions videotapes by two independent observers. Outcomes assessed included (a) observer reports of mastery rate of

**TABLE 2—(Continued)**

Study	Research Design <sup>a</sup>	Dependent Measures	Natural Intervention Setting	Intervention Agent	PECS Phase	Average Length of Follow-up	Fidelity <sup>b</sup>	Reliability
Magiati & Howlin (2003)	(S) O <sub>1</sub> XO <sub>2</sub> O <sub>3</sub>	PECS acquisition	Y	Teachers	I-VI	6 months	C	N/A
	Qualitative research	PECS acquisition	Y	Teachers	I-VI	N/A	M	N/A
Schwartz et al. (1998)	(S) XO <sub>1</sub> O <sub>2</sub> O <sub>3</sub> O <sub>4</sub>	a. Spontaneous speech b. Communicative forms c. Communicative functions d. Communicative acts	Y	Teachers	N/A	12 months	M	Y
Tincani (2004)	(S) Alternative treatments	a. Motor imitation b. Mands c. Word vocalization	Y	Experimenters	I-III	N/A	O	Y

\* N/A = Information not available in the article.

<sup>a</sup> (S) = Single subject, O = Different assessment phases of a study, X = PECS intervention phase of study.

<sup>b</sup> M = Implementer used intervention manual containing strategies of PECS, C = Implementer demonstrated mastery of strategies to acceptable criterion, O = Objective observer coded observations for adherence to PECS during sessions.

<sup>c</sup> Y = Reliability data reported.

PECS acquisition, (b) frequency of spontaneous requests initiated by participants, (c) method and function of the participants' communication, and (d) number of pictures and spoken words used by the participants following introduction of PECS. In addition, participants' behavior outcomes were measured in three studies, Anderson (2002), Charlop-Christy et al. (2002), and Magiati and Howlin (2003). The behavior outcomes examined included frequency of problem behaviors participants engaged in and the incidence of frustration showed by participants.

### Synthesis Findings

Table 3 summarizes the findings of the synthesis regarding the communication outcomes of PECS reported across studies. The summary includes a description of the influence of the PECS training on functional communication outcomes as reported in each study. In addition, it contains information about the degree to which change in communication status was demonstrated as a direct result of the PECS training. As illustrated,

there was little variation across the 13 studies regarding the specificity of documenting appropriate implementation of PECS.

For purposes of the synthesis, studies that lacked data demonstrating implementers' mastery of the PECS skills were categorized as having Low Specificity ( $N = 0$ ; 0%). Studies that provided evidence of implementers' mastery of PECS skills but did not report any treatment-fidelity procedures were categorized as having Moderate Specificity ( $N = 9$ ; 69%). Finally, studies that provided data regarding implementers' skill mastery and the treatment fidelity procedures used were classified as High Specificity studies ( $N = 4$ ; 31%). The studies with High Specificity provided the strongest evidence that change in communication outcomes were a direct consequence of the PECS training.

### Results

*Communication consequence.* Across the studies, participants who received the PECS training experienced positive gains in functional communication skills. Thus, communi-

**TABLE 3**

**Major Findings**

<i>Study</i>	<i>Communication Consequences</i>	<i>Other Consequences</i>	<i>Report of Generalization<sup>a</sup></i>	<i>Relation to PECS<sup>b</sup></i>
Adkins & Axelrod (2002)	The use of PECS produced a better acquisition rate, more spontaneous usage, and a higher generalization rate than the use of sign language for the child with PDD.	The child appeared to be able to achieve correspondence to the presented object.	Y	M
	PECS was a more effective method for the child with PDD, and it generalized under different conditions. PECS was the preferred response method used by the child. The child began to imitate some sounds and one-syllable words			
Anderson (2002)	For the majority of the children, rates of acquisition in the PECS condition were uniformly faster than rates of acquisition in the sign language condition.	Five of the six children demonstrated more eye contact in the sign language condition than in the PECS condition.	Y	H
	All of the children mastered more items in the PECS condition than in the sign language condition.	Several children began vocalizing during treatment in both the sign language and PECS conditions. However, the three children who vocalized during correct responding did so significantly more often in the sign language condition than in the PECS condition.		
	All the children demonstrated response generalization in the PECS condition; four out of the six children demonstrated skill generalization in the sign language condition.	Tantrum and avoidance behaviors decreased for all the children in both PECS and sign language conditions.		
	Three of the children appeared to behaviorally prefer PECS; the other three children appeared to behaviorally prefer sign language.	Three of the six participants demonstrated significant increases in positive affect in the sign language condition, while only one significant increase was found in the PECS condition.		
	All the children initiated with PECS more often than with sign language when both modalities were available.	Two children demonstrated more self-stimulation in the sign language condition, while two children engaged in significantly more self-stimulated in the PECS condition.		
	The three children who appeared to prefer sign language initiated the greatest number of sign trials during the free choices without PECS probes.			

**TABLE 3—(Continued)**

Study	Communication Consequences	Other Consequences	Report of Generalization <sup>a</sup>	Relation to PECS <sup>b</sup>
	All the children demonstrated approximately 30.7 more spontaneous initiations per hour if they were using sign language than if they were using PECS.			
Charlop-Christy et al. (2002)	All three children mastered PECS use within a relatively short time. All children showed increases in spontaneous/imitation speech and mean length of utterance. All children had collateral gain in social-communicative behavior, such as joint attention and eye contact, following the PECS training.	A 70% or greater reduction was observed for 10 of 12 problem behaviors, and four problem behaviors were eliminated.	N	M
Ganz & Simpson (2004)	All three children made progress in mastery of the PECS system and demonstrated increases in average intelligible words spoken per trial. All participants began Phase I without word utterances or speaking in one-word utterances and ended phase IV speaking three- to four-word-phases. All three children began using longer phrases and speaking with more complex syntax by the end of the PECS training. One child showed a decrease in non-word vocalizations, while one child showed an increase. The third one appeared relatively stable.		Y	M
Heneker & Page (2003)	The children were using more sophisticated forms of communication and need less prompting to do so. Requesting was the main function of communication. The children were observed to use symbols as the main methods of communication. The children appeared to have learned the importance of needing somebody's attention before communicating with them.	The children did not show an increase in spontaneously gaining the adult's attention. The children appeared to show less frustration and were able to accept the fact that they could not always have what they had asked for.	Y	M

**TABLE 3—(Continued)**

Study	Communication Consequences	Other Consequences	Report of Generalization <sup>a</sup>	Relation to PECS <sup>b</sup>
	<p>The children were spontaneously attempting to exchange the symbols in 95% of cases.</p> <p>Requesting was the main function of communication.</p> <p>The children were observed to move towards using more formal methods of communication across all contexts.</p> <p>Spontaneous exchange occurred on average 96% of the time for all interactions that involved a symbol.</p>	<p>The children showed an increase in spontaneously gaining the adult's attention.</p>	N	M
Jones (2005)	<p>The PECS training was highly successful for three of the five children. They learned to use target utterances, made gains in length and variability of spontaneous utterances, generalized those gains across items and people, and maintained those gains.</p> <p>One of the five children showed only minimal change (no generalization and no change in variability) in spontaneous speech. The remaining one did not show gains in spontaneity, but did show important gains in the prerequisite skill of imitation.</p> <p>Four out of the five children showed an increase in their mean length of utterances for training items after the PECS training.</p> <p>Three children showed an increase in word variation during the PECS and time-delay sessions. One child showed no increases in new word use after the preliminary increases seen in baseline, while one child introduced new words during each of the procedural phases of the study and followup.</p> <p>Four of the five children began to use target utterances spontaneously during PECS and time-delay sessions. Only one maintained this ability during followup, and only one generalized this ability across communicative partners.</p> <p>One child significantly increased his ability to expressively label attributes; the remaining four children remained level through PECS.</p>	<p>Two children increased their ability to imitate target utterances, while one child decreased her ability to imitate.</p>	Y	H

**TABLE 3—(Continued)**

Study	Communication Consequences	Other Consequences	Report of Generalization <sup>a</sup>	Relation to PECS <sup>b</sup>
Kravits et al. (2002)	<p>The child demonstrated successful use of PECS.</p> <p>The child's spontaneous language, which includes verbalizations and icon use, increased with the intervention.</p> <p>The child demonstrated significantly more initiations and verbalizations during intervention sessions than during baseline session.</p> <p>The child did not significantly increase the range of spoken vocabulary during intervention.</p> <p>The duration of the child's peer interactions significantly increased.</p>		Y	M
Liddle (2001)	<p>Twenty of the children learned to use PECS to request items, and one child failed to achieve phase I.</p> <p>Eleven out of 20 children who learned to use PECS learned to use sentence strips to request items. The remaining nine children improved in their ability to interact with others by being able to initiate requesting.</p> <p>Nine out of 21 children were been observed to have increased their attempts at spoken language.</p>		Y	M
Magiati & Howlin (2003)	<p>The children showed significant improvements in their use of PECS, with the level of PECS, frequency of the PECS use, and extent of PECS vocabulary all increasing over time.</p> <p>The children were found to show an improvement in their overall level of communication. There were increases in the children's use of the other forms of communication, such as signs/gestures, spoken words and phrases.</p> <p>Changes in the less speech group were slow to occur, but became marked over time. For children with higher level of speech large gains occurred initially, but these tended to be plateau out.</p>	<p>There was a significant reduction in the children's total score on the Rimland Autism treatment Evaluation Check-list (from a mean of 74.9, <i>SD</i> = 20.98 to 65.1, <i>SD</i> = 20.89, <i>t</i> = 3.91, <i>p</i> &lt; .001), indicating an overall improvement in problem behaviors.</p>	Y	M

**TABLE 3—(Continued)**

<i>Study</i>	<i>Communication Consequences</i>	<i>Other Consequences</i>	<i>Report of Generalization<sup>a</sup></i>	<i>Relation to PECS<sup>b</sup></i>
Schwartz et al. (1998)	14 months on average (range = 3-28 months) after the beginning of PECS training, children were using the PECS system in a functional manner to communicate with adults and peers.		Y	M
	The children mastered the fundamental PECS protocol within 11 months, and learned to exchange with peers in an additional 3 months.			
	Children who learned PECS use the system across settings. Forty-four percent of the children acquired unprompted, non-echolalic spoken communication, and all children demonstrated many successful communicative interactions across trained and untrained functions and settings.			Y
	Children who received training in one communicative function demonstrated increased use of different untrained communicative functions.			
Tincani (2004)	One child with weak hand-motor imitation skills learned PECS more rapidly than sign language. On the other hand, another child with moderate imitation skills learned sign language more rapidly than PECS.		Y	H
	Sign language training produced more vocalization for both children; however, a procedural modification to the PECS system increased one child's vocalization to a level similar to that in sign language training.			

<sup>a</sup> Y = Yes, N = No.

<sup>b</sup> H = High specificity, M = moderate specificity, L = Low specificity (see text for a more detailed description of specificity ratings).

cative behavior change was documented in all studies. The most commonly reported communication consequences of PECS included: (a) successful use of PECS as a communication tool (reported in 100% studies); (b) an increase in overall level of communication and language (reported in 62% studies); (c) an increase in spontaneous language/speech/imitation (reported in 46% studies); (d) an increase in initiations of communication (reported in 31% studies); and (e) an increase in mean length of utterance (re-

ported in 23% studies). Furthermore, the studies that included a follow-up assessment indicated maintenances of the gains identified at the time of posttesting (Charlop-Christy et al., 2002; Heneker & Page, 2003; Jones, 2005; Magiati & Howlin, 2003; Schwartz et al., 1998).

The studies that compared PECS against sign language training demonstrated that (a) rates of acquisition in PECS were faster than rates of acquisition in sign language, (b) PECS was the preferred method of communication for most participants compared

to sign language, and (c) PECS was associated with significantly greater improvements for the participants without hand-motor imitation relative to the sign language training (Adkins & Axelrod, 2002; Anderson, 2002; Tincani, 2004).

*Other consequences.* Positive behavioral change was documented in three of the studies (Anderson, 2002; Charlop-Christy et al., 2002; Magiati & Howlin, 2003). The most commonly reported behavior consequence were significant reductions in problem behaviors.

### *Rival Explanations*

A number of rival explanations might explain the positive findings reported in the studies reviewed in this synthesis. However, many of these rival explanations can be refuted as a consequence of the generally high quality of the research designs.

First, the fact that studies typically employed observational coding as the primary method of data collection could have resulted in observer or rater bias. However, every study employed two independent observational data recorders and sections of different intervention phases (e.g., baseline, intervention). Moreover, with strong reliability data reported for eight of the 13 (62%) studies available, concerns that measurement variations in maternal interactions were a result of observer bias are minimized.

Second, the positive changes of communication consequences may have been emerged as part of maturation. However, this possibility is mitigated by the fact that many behavioral, social, and communicative deficits exhibited by children with autism spectrum disorders do not spontaneously remit over time if untreated (American Psychiatric Association, 2000). In addition, 12 out of 13 studies used a single-subject design, and single-subject design methodology establishes the casual relationship between treatment and outcomes by as series of intrasubject or intersubject replications of treatment effect (National Research Council, 2001). Furthermore, in single-subject, multiple-baseline designs, participants serve as their own control group. The presence of a control group can serve to separate

the effects of maturation and those of treatments.

Third, the fact that the experimenter him/herself implemented the treatment in several of the studies could lead to problem with experimenter bias; that is, the experimenter might influence the participant's responses. However, this concern is mitigated somewhat by the fact that in most of the studies reviewed (62%), the person implementing PECS was someone other than the experimenter.

In summary, a number of common threats to internal validity were addressed within the research designs of these studies. Therefore, despite such potential threats to the generalizability of the practice, the synthesis findings support the effectiveness of the PECS training.

### **Conclusion**

The primary focus of this synthesis of the literature was to summarize findings regarding the effectiveness of PECS for enhancing the functional communication skills of children with ASD. In brief, the evidence for the intervention's effectiveness was provided by studies that (a) assessed the level of adherence to a standardized treatment protocol (i.e., treatment fidelity); (b) utilized appropriate and well-executed research designs; (c) used measures with well-established reliability to assess outcomes; (d) replicated finding across participants; and (e) employed a follow-up component to demonstrate the stability of treatment effects. Taken as a whole, therefore, results of the studies reviewed provide evidence for the effectiveness of PECS; specifically, PECS is effective in enhancing functional communication skills of individuals with ASD. Therefore, PECS is recommended as an evidence-based intervention for this purpose.

Nevertheless, several points should be considered regarding recommending of PECS as an evidence-based intervention. First, most of the participants of the studies included in this synthesis were male (65%), which most likely is a reflection of the differential prevalence rates of autism across genders. The pattern of gains exhibited by the participants was similar for males and females, which indicates that the PECS training had the same effect regardless of gender.

Second, children in the studies were diag-

nosed as having ASD. Therefore, PECS can only be recommended as an evidence-based intervention for individual with ASD, rather than for individuals with other diagnoses. Further research involving individuals with other types of diagnoses will be needed to determine whether or not PECS is effective as a functional communication intervention for other populations.

### Implications for Practice

For practitioners working the children with ASD, there are two primary implications for practice that can be derived from this research synthesis. First, PECS training can easily be incorporated into an individual's usual routine without requiring large-scale changes to class or home routines. Thus, similar programs may successfully be implemented by teachers and parents. Second, the value of PECS may lie not only in its ability to enhance communication skills initially, but also to facilitate easy maintenance and application to new situations. This is especially critical when considering that other interventions sometimes require constructed environments and, therefore, are not likely to generalize outside of specially designed environments.

In summary, the evidence reviewed in this synthesis supports claims the PECS is effective in enhancing functional communicational skills of children with ASD. In addition, the implications derived from this synthesis suggested that PECS can be easily integrated into an individual's usual routing and that the skills acquired from PECS training can be maintained and generalized across different situations. Insofar, PECS is recommended as an evidence-based intervention for enhancing functional communication skills of individuals with ASD. However, further research involving individuals with other types of disabilities is recommended.

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