Picture Exchange Communication System With Individuals With Developmental Disabilities: A Meta-Analysis of Single Subject Studies
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What is This?
Picture Exchange Communication System With Individuals With Developmental Disabilities: A Meta-Analysis of Single Subject Studies

Stephanie L. Hart¹ and Devender R. Banda¹

Abstract

Picture Exchange Communication System (PECS) is a picture-based communication strategy used to teach communication skills to persons with developmental disabilities including autism. This article systematically reviews 13 published single-subject studies to examine the effectiveness of PECS, the effects of PECS on speech and problem behaviors, generalization beyond training conditions, and social validity of the intervention. The authors also calculated percentage of nonoverlapping data points for all participants to quantify, compare, and analyze results. Results indicate that PECS yielded increases in functional communication in all but 1 participant. Additionally, PECS decreased problem behaviors and increased speech in some individuals. A theoretical framework, analyses of methodologies, and implications for researchers and practitioners are discussed.

Keywords

autism, communication, developmental disability, functional communication, picture exchange communication system, PECS, picture exchange, speech

People with developmental disabilities, including autism, often have significant communication problems (Sigafoos & Drasgow, 2001; Sigafoos & Pennell, 1995). A lack of functional communication skills leaves individuals with communication impairments unable to communicate wants or needs, communicate refusals or agreements, or engage in social conversations (Scott, Clark, & Brady, 2000). As many as 1.3% of all individuals in the United States, including 50% of people with autism, have communication disabilities so extensive that they cannot express their daily communication needs through natural speech (Dyches, 1998; Koul, Schlosser, & Sancibrian, 2001; Prizant, 1996). For these people, severely restricted communication affects all aspects of life, including education, employment, family, and community (Beukleman & Mirenda, 2005). In educational settings, students with communication impairments have no way to request items or activities, ask for help, ask for a break, or respond to questions (Bondy & Frost, 2001b). As the number of students with autism increases, the need for teachers and schools to implement instructional methods that address students’ communication impairments also increases.

Several strategies have been used to improve communication behaviors in persons with autism or other developmental disabilities, including discrete trial teaching (see Buffington, Krantz, McClannahan, & Poulson, 1998; Koegel, O’Dell, & Dunlap, 1988; Lovaas, 1981), Milieu Teaching (Koegel, O’Dell, & Koegel, 1987; Neef, Walters, & Egel, 1984), sign language (Layton, 1988; Yoder & Layton, 1988), and functional communication training (Carr & Durand, 1985; Durand & Carr, 1992). Many traditional language programs, including speech therapy and sign language, emphasize acquiring the social aspects of communication, such as eye contact or motor and verbal imitation skills, before a child progresses to attempts at functional communication (Bondy & Frost, 1994). Programs that focus on a child’s prerequisite or readiness skills might leave a child perpetually working to master prerequisite skills rather than receiving strategies and instruction to develop functional communication skills (Hourcade, Pilotte, West, & Parette, 2004). Furthermore, because infrequent eye contact and poor imitation skills are defining characteristics of autism (American Psychiatric Association, 2000), many children taught with traditional language programs could take weeks or even months to master and move beyond these prerequisite skills (Bondy & Frost).

¹Texas Tech University, Lubbock, TX

Corresponding Author:
Stephanie L. Hart, MS 41071, College of Education, Texas Tech University, Lubbock, TX 79409, USA
Email: stephanie.hart@ttu.edu
Picture Exchange Communication System (PECS) is an augmentative and alternative communication system (AAC) that is used to supplement or replace natural speech for individuals without functional speech. Unlike other AAC systems, PECS is unique in that it does not require prerequisite skills, such as pointing, labeling, or matching, but rather teaches individuals to request preferred items, which is a functional skill maintained by consequent access to preferred reinforcers (Lancioni et al., 2007). Whereas PECS does involve skills such as establishing joint attention, labeling, and matching, these skills are embedded into the protocol rather than being taught prior to intervention (Hourcade et al., 2004).

PECS represents a departure from previous attempts to teach communication skills to children with autism or other developmental disabilities by teaching functional communication skills through nonverbal prompts and physical exchanges. PECS teaches the student to exchange a picture for a preferred item to initiate communication within a social context (Bondy & Frost, 1994; Lancioni et al., 2007). During PECS instruction, communication is nonverbal and child-initiated. The child is prompted using hand-over-hand techniques and visual cues rather than verbal prompts. The hand-over-hand prompting fades, and the child learns to make spontaneous requests. Thus, functional communication becomes possible for children who are not verbal because they are able to independently communicate their wants and needs using pictures (Scott, Clark, & Brady, 2000; Sigafoos, 2005).

PECS has six distinct training phases (Bondy & Frost, 1994): (1) physical exchange, (2) expanding distance, (3) picture discrimination, (4) sentence structure, (5) answering “What do you want?” and (6) commenting. The first three phases of PECS involve making requests through a simple exchange. In the first phase, the child is taught to initiate a request by trading a picture of a desired object, such as a ball, for the object itself while seated at a table across from his or her communication partner. The second phase expands the first phase by having the child seek out the communication partner in the classroom to make the exchange and receive the item. In the third phase, the child learns to discriminate between several pictures of desired items, locate the picture of the item he or she wants, locate the communication partner, and exchange the picture for the desired item (Bondy & Frost, 2001b).

The remaining phases of PECS involve using sentences through pictures to make requests or comments. In the fourth phase, the child learns to request an object by constructing a sentence using a card saying “I want” and a picture of the desired object. Upon exchange, the partner reads the sentence strip aloud (e.g., “I want ball”) while the child touches the “I want” card and then the picture card. In the fifth phase, the child learns to request specific items, such as a red ball. Cards depicting various descriptors are added to the binder, and the child is prompted to use the “I want,” red, and ball pictures to construct the sentence “I want red ball” on the sentence strip. In the sixth phase, sentence structure is expanded to encourage spontaneous nonverbal comments about the child’s environment, such as “I see ball.” Rather than handing the object to the child, the partner responds to the comment, such as “I see the ball, too! It is on the table” (Bondy & Frost, 2001b). Thus, the child progresses from using single words to descriptive phrases to sentences. For a detailed description of PECS stages and implementation procedures, refer to Frost and Bondy (1994, 2002).

PECS first appeared in the literature in 1993 when Bondy and Frost reported its use to facilitate communication in children and adults with developmental disabilities. Anecdotal reports indicate that PECS training resulted in a higher rate of communication attempts in the participants (Bondy & Frost, 1993). Although PECS has been widely used by practitioners and has been the focus of numerous single-subject and group designs, no known comprehensive reviews of single-subject design studies have been conducted. For example, Miranda (2003) conducted a review exploring aspects of aided and unaided AAC techniques, particularly whether aided AAC systems such as PECS promoted the development of natural speech. The author reviewed numerous AAC studies and included 4 PECS studies, 2 using single-subject design, 1 using a group design, and 1 descriptive study. Miranda concluded that the limited research on aided AAC techniques, such as PECS, indicated a facilitative effect on speech. Also, Millar, Light, and Schlosser (2006) conducted a meta-analysis to examine the effect of AAC on the speech production of individuals with developmental disabilities. After reviewing 23 studies, the authors limited the meta-analysis to 6 studies, including 1 PECS study, which established experimental control as described by Slavin (1986). Millar et al. concluded that the use of AAC devices facilitated speech in 89% of participants and confirmed that there was no loss of speech in any participant due to using AAC devices. In another study, Lancioni et al. (2007) published a qualitative review of literature on PECS and Voice Output Communication Aid (VOCA) to describe the effectiveness of each method to increase requesting in 173 students with developmental disabilities. The authors classified 37 studies, including 6 single-subject PECS studies, into three categories: PECS or equivalents, VOCAs or equivalents, and PECS versus VOCA. The use of PECS and/or VOCAs were reported to be successful interventions for 169 of the 173 participants.

Aside from references to PECS in broader AAC studies, there is no systematic and comprehensive review of available single-subject studies of PECS analyzing variables such as participant characteristics, communication abilities, individual phases of PECS, effects of PECS on decreasing problem behaviors, and effectiveness of PECS measured using percentage of nonoverlapping data points (PND). It is crucial for practitioners and researchers to know the current status of PECS in terms of its effectiveness, suitability with particular students, and potential social validity (see Simpson, 2005).
The purpose of this review is to conduct a systematic analysis of PECS single-subject studies conducted with individuals with developmental disabilities. Specifically, six research questions were addressed in this review: (a) What is the effectiveness of PECS interventions in enhancing communication skills? (b) To what extent does PECS increase speech? (c) To what extent does PECS decrease problem behaviors? (d) To what extent do skills learned through PECS generalize to untrained persons, settings, or behaviors? (e) To what extent is PECS a socially valid intervention? (f) To what extent are the PECS single-subject studies methodologically rigorous?

Method

Search Procedures and Selection Criteria

An electronic-based search was conducted using Academic Search Premier, ERIC, and PsycINFO with the terms autism, communication, developmental disability, functional communication, picture exchange communication system, PECS, picture exchange, and speech. Ancestral searches of articles referenced in the included studies were also conducted. Included in this review were studies that (a) taught participants with autism or developmental disabilities any or all of the six PECS training phases, (b) used PECS as an intervention rather than an assessment tool, (c) were published between the development of the PECS system in 1994 and the end of 2007, (d) used single-subject research designs that contained at least one demonstration of a functional relationship between the independent and dependent variable (Kazdin, 1982; Tawney & Gast, 1984), (e) were published in peer-reviewed journals, and (f) were available in English. Thirteen studies met the selection criteria. Excluded studies were those that used PECS as an assessment tool rather than as an intervention (Rosales & Rehfeldt, 2007; Sidener, Shabani, Carr, & Roland, 2006), case studies or AB designs that lack direct replication (Anderson & Moore, 2007; Dooley, Wilczenski, & Torem, 2001; Malandraki & Okalidou, 2007; Simon, Whitehair, & Toll, 1996), single-subject studies without reported baseline (Cummins & Williams, 2000; Ganz & Simpson, 2004), or group studies (e.g., Howlin, Gordon, Pasco, Wade, & Charman, 2007; Schwartz, Garfinkle, & Bauer, 1998).

Coding Procedures

We reviewed and coded studies that met the inclusion criteria. We coded each study in the following categories: (a) participant age, disability, cognitive levels, and communication abilities; (b) setting; (c) target behaviors; (d) PECS phases taught; (e) modifications to PECS protocol; (f) additional interventions, if applicable; (g) interobserver agreement; (h) procedural integrity; (i) social validity; (j) maintenance; (k) generalization; and (l) PND.

Calculation of PNDs and Criteria for Effectiveness

We calculated PNDs for participants in the 13 studies. PND is calculated by determining the percentage of intervention data points that are not overlapping with the highest data point in baseline (Scruggs, Mastropieri, & Casto, 1987). For studies that used alternating treatments design with baseline condition, we coded the PND for the individual treatments as separate cases for each participant (Schlosser & Lee, 2000). To evaluate the effectiveness of the PECS intervention, we used the criteria set by Scruggs, Mastropieri, Cook, and Escobar (1986) for each participant. A PND of 91% or higher indicated that the intervention was highly effective, PND values ranging from 71% to 90% indicated moderately effective, PND values from 50% to 70% indicated minimally effective, and PND values below 50% indicated that intervention had little to no effect on the participant.

Interrater Agreement

Interrater agreement was used for search procedures, coding, and PND calculations. The first author searched for and selected studies that met the inclusion criteria. The second author independently searched for and confirmed studies that met the criteria for selection. Upon agreement of both authors, additional studies that met the search criteria were incorporated throughout the writing process to reflect ongoing research in the field. A total of 13 studies that met the inclusion criteria were located by the first author and then confirmed by the second author. The first author coded all 13 studies, and the second author coded 30% of studies for variables listed in Tables 1 and 2. When both raters agreed on a particular variable, the variable was coded as agreed, and when both raters disagreed on a variable it was coded as disagreed. The interrater agreement was calculated using the number of agreements divided by number of agreements plus number of disagreements multiplied by 100. Interrater agreement was 100% for all listed variables. The second author calculated PNDs for all 13 studies. The first author then independently calculated PNDs for 30% of studies (4 studies). For PNDs, interrater agreement was calculated using the following formula for each study: lowest PND divided by highest PND and multiplied by 100. Interrater agreement for PNDs was 99% (range 95% to 100%). For more details on each included study, refer to Tables 1 and 2.

Results

Participants

Age and disabilities. A total of 36 participants with developmental disabilities participated in the 13 studies. Of the 36 participants, 30 were male and 6 were female. The
Table 1. Participant Characteristics and Results

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Participant Age, Disability, and Cognitive Levels</th>
<th>Communication Abilities</th>
<th>Independent Variable</th>
<th>Dependent Variable</th>
<th>Percentage of Nonoverlapping Data Points (PND)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bock, Stoner, Beck, Hanley, &amp; Prochnow (2005)</td>
<td>4y, male with DD, IQ n/a</td>
<td>Nonverbal</td>
<td>PECS Phases 1–3, VOCA</td>
<td>Mands</td>
<td>87 PECS, 77 VOCA</td>
</tr>
<tr>
<td></td>
<td>4y, male with DD, IQ n/a</td>
<td>Nonverbal</td>
<td>PECS Phases 1–3, VOCA</td>
<td>Mands</td>
<td>86 PECS, 64 VOCA</td>
</tr>
<tr>
<td></td>
<td>4y, male with DD, IQ n/a</td>
<td>Nonverbal</td>
<td>PECS Phases 1–3, VOCA</td>
<td>Mands</td>
<td>86 PECS, 79 VOCA</td>
</tr>
<tr>
<td></td>
<td>4y, male with DD, IQ n/a</td>
<td>Nonverbal</td>
<td>PECS Phases 1–3, VOCA</td>
<td>Mands</td>
<td>100 PECS, 82 VOCA</td>
</tr>
<tr>
<td></td>
<td>4y, male with DD, IQ n/a</td>
<td>Nonverbal</td>
<td>PECS Phases 1–3, VOCA</td>
<td>Mands</td>
<td>100 PECS, 91 VOCA</td>
</tr>
<tr>
<td></td>
<td>4y, male with DD, IQ n/a</td>
<td>Nonverbal</td>
<td>PECS Phases 1–3, VOCA</td>
<td>Mands</td>
<td>100 PECS, 91 VOCA</td>
</tr>
<tr>
<td>Buckley &amp; Newchok (2005)</td>
<td>7y, male with autism, motor deficits, IQ n/a</td>
<td>Limited expressive language, simple picture exchange</td>
<td>PECS Phases 1–2</td>
<td>Reduce aggression, increase picture exchanges</td>
<td>97 decreased aggression, no baseline for exchanges</td>
</tr>
<tr>
<td>Chambers &amp; Rehfeldt (2003)</td>
<td>19y, male with MR, IQ 22</td>
<td>Labels few objects</td>
<td>PECS Phases 1–3, sign language</td>
<td>Mands for items not in view</td>
<td>100 PECS, 68 signs</td>
</tr>
<tr>
<td></td>
<td>26y, male with MR, CP, IQ 27</td>
<td>Vocalizations</td>
<td>PECS Phases 1–3, sign language</td>
<td>Mands for items not in view</td>
<td>100 PECS, 0 signs</td>
</tr>
<tr>
<td></td>
<td>40y, female with Downs, MR, IQ &lt; 18</td>
<td>Gestures, imitates 12 words</td>
<td>PECS Phases 1–3, sign language</td>
<td>Mands for items not in view</td>
<td>100 PECS, 95 signs</td>
</tr>
<tr>
<td></td>
<td>36y, female with MR, IQ 24</td>
<td>Nonverbal, gestures, points, touches, grabs</td>
<td>PECS Phases 1–3, sign language</td>
<td>Mands for items not in view</td>
<td>100 PECS, 50 signs</td>
</tr>
<tr>
<td>Charlop-Christy, Carpenter, Le, LeBlanc, &amp; Kellet (2002)</td>
<td>12y, male with autism, IQ n/a</td>
<td>Gestures, little spontaneous speech</td>
<td>PECS Phases 1–6</td>
<td>Increase speech and social behavior</td>
<td>40 speech and social behavior behavior</td>
</tr>
<tr>
<td></td>
<td>3y, male with autism, IQ n/a</td>
<td>Gestures, imitation, no spontaneous speech</td>
<td>PECS Phases 1–6</td>
<td>Increase speech and social behavior, decrease problem behavior</td>
<td>86 speech and social behavior</td>
</tr>
<tr>
<td></td>
<td>5y, male with autism, IQ n/a</td>
<td>Leading, pointing, imitation, no gestures or spontaneous speech</td>
<td>PECS Phases 1–6</td>
<td>Increase speech and social behavior, decrease problem behavior</td>
<td>51 speech and social behavior</td>
</tr>
<tr>
<td>Frea, Arnold, &amp; Vittimberga (2001)</td>
<td>4y, male with autism, MR, IQ n/a</td>
<td>Nonverbal</td>
<td>PECS Phases 1–3</td>
<td>Decrease aggressive behavior</td>
<td>86 decreased aggression</td>
</tr>
<tr>
<td></td>
<td>6y, female with autism, IQ n/a</td>
<td>I- to 2-word phrases</td>
<td>PECS Phases 1–3</td>
<td>Increase initiations and verbalizations</td>
<td>90 initiations and verbalizations</td>
</tr>
<tr>
<td>Marckel, Neef, &amp; Ferreri (2006)</td>
<td>5y, male with autism, IQ n/a</td>
<td>Used PECS fluently, showed match-to-sample skills for shapes and actions</td>
<td>PECS Phase 5</td>
<td>Use function, shape, and color to request seen and unseen objects</td>
<td>100 requesting</td>
</tr>
<tr>
<td></td>
<td>4y, male with autism, IQ n/a</td>
<td>Used PECS fluently, showed match-to-sample skills for shapes and actions</td>
<td>PECS Phase 5</td>
<td>Use function, shape, and color to request seen and unseen objects</td>
<td>98 requesting</td>
</tr>
<tr>
<td>Sigafoos, Ganz, O'Reilly, Lancioni, &amp; Schlosser (2007)</td>
<td>16y, male with PDD, MR, IQ n/a</td>
<td>Nonverbal, reaching, leading, few manual signs</td>
<td>PECS Phase 1</td>
<td>Manding for snack items</td>
<td>100 manding</td>
</tr>
<tr>
<td></td>
<td>12y, male with autism, IQ n/a</td>
<td>Nonverbal, reaching, leading, few manual signs</td>
<td>PECS Phase 1</td>
<td>Manding for snack items</td>
<td>100 manding</td>
</tr>
</tbody>
</table>

(continued)
Table 1. (continued)

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Participant Age, Disability, and Cognitive Levels</th>
<th>Communication Abilities</th>
<th>Independent Variable</th>
<th>Dependent Variable</th>
<th>Percentage of Nonoverlapping Data Points (PND)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Son, Sigafoos, O’Reilly, &amp; Lancioni (2006)</td>
<td>5y, female with autism, IQ n/a</td>
<td>Nonverbal</td>
<td>PECS Phase 3, VOCA</td>
<td>Manding with correct picture of food offered</td>
<td>67 PECS, 67 VOCA</td>
</tr>
<tr>
<td></td>
<td>3y, female with autism, IQ n/a</td>
<td>Nonverbal</td>
<td>PECS Phase 3, VOCA</td>
<td>Manding with correct picture of food offered</td>
<td>73 PECS, 73 VOCA</td>
</tr>
<tr>
<td></td>
<td>3y, male with PDD, IQ n/a</td>
<td>Few vocalizations and gestures</td>
<td>PECS Phase 3, VOCA</td>
<td>Manding with correct picture of food offered</td>
<td>50 PECS, 75 VOCA</td>
</tr>
<tr>
<td>Stoner et al. (2006)</td>
<td>30y, male with MR, Downs, IQ 35–49</td>
<td>Few signs, gestures</td>
<td>PECS Phases 1–4</td>
<td>Increasing percentage of mands</td>
<td>100 mands</td>
</tr>
<tr>
<td></td>
<td>22y, male with MR, Downs, IQ 20–34</td>
<td>Physical contact</td>
<td>PECS Phases 1–4</td>
<td>Increasing percentage of mands</td>
<td>98 manding</td>
</tr>
<tr>
<td></td>
<td>22y, male with MR, IQ 20–34</td>
<td>Distal pointing</td>
<td>PECS Phases 1–4</td>
<td>Increasing percentage of mands</td>
<td>97 manding</td>
</tr>
<tr>
<td></td>
<td>3y, male with MR, CP, IQ &lt; 20</td>
<td>Idiosyncratic gestures</td>
<td>PECS Phases 1–4</td>
<td>Increasing percentage of mands</td>
<td>65 manding</td>
</tr>
<tr>
<td></td>
<td>30y, male with MR, seizures, IQ &lt; 20</td>
<td>1- to 2-word phrases, idiosyncratic gestures</td>
<td>PECS Phases 1–4</td>
<td>Increasing percentage of mands</td>
<td>80 manding</td>
</tr>
<tr>
<td>Tincani (2004)</td>
<td>5y, male with autism, MR, IQ n/a</td>
<td>Gestures, vocal imitation</td>
<td>PECS Phase 1–3, sign language</td>
<td>Motor imitations, mands, word vocalizations</td>
<td>73 mands PECS, 100 words</td>
</tr>
<tr>
<td></td>
<td>6y, female with PPD, MR, IQ n/a</td>
<td>Gestures, vocal imitation</td>
<td>PECS Phase 1–3, sign language</td>
<td>Motor imitations, mands, word vocalizations</td>
<td>100 mands PECS, 100 words</td>
</tr>
<tr>
<td>Tincani, Crozier, &amp; Alazetta (2006)</td>
<td>10y, male with autism, IQ n/a</td>
<td>No functional speech</td>
<td>PECS Phases 1–4</td>
<td>Manding, measurable speech</td>
<td>100 mands PECS, overall PECS PND: 100, 78 mands sign, 100 words sign, overall sign PND: 89</td>
</tr>
<tr>
<td></td>
<td>11y, male with autism, IQ n/a</td>
<td>No functional speech</td>
<td>PECS Phases 1–2</td>
<td>Manding, measurable speech</td>
<td>100 mands, 11 vocalization, overall PND: 56</td>
</tr>
<tr>
<td></td>
<td>9y, male with autism, IQ n/a</td>
<td>Some PECS use</td>
<td>PECS Phase 4</td>
<td>Manding, measurable speech</td>
<td>100 mands, no PND for speech</td>
</tr>
<tr>
<td>Yokoyama, Naoi, &amp; Yamamoto (2006)</td>
<td>5y, male with autism, IQ n/a</td>
<td>No functional vocalizations, gestures, a sound</td>
<td>PECS Phases 1–6</td>
<td>Exchanges, increased vocalizations</td>
<td>93 exchanges, no PNDs for vocalization</td>
</tr>
<tr>
<td></td>
<td>5y, male with autism, IQ n/a</td>
<td>No functional vocalizations, sounds, pulling</td>
<td>PECS Phases 1–6</td>
<td>Exchanges, increased vocalizations</td>
<td>79 exchanges, no PNDs for vocalization</td>
</tr>
<tr>
<td></td>
<td>5y, male with autism, IQ n/a</td>
<td>Nonverbal, one word from prior PECS training</td>
<td>PECS Phases 1–6</td>
<td>Exchanges, increased vocalizations, vocalizations</td>
<td>95 exchanges, no PNDs for vocalization</td>
</tr>
</tbody>
</table>

Note: DD = developmental disability; IQ = Intelligence Quotient; PECS = Picture Exchange Communication System; VOCA = Voice Output Communication Aid; MR = mental retardation; CP = cerebral palsy; PDD = pervasive developmental disorder.
participants ranged in age from 3 years to 40 years, with an average age of 11 years. Two studies with a total of 9 participants were conducted with adults, ranging in age from 19 to 40 years, with an average age of 28 years (Chambers & Rehfeldt, 2003; Stoner et al., 2006). The remaining studies were conducted with school-aged participants, ranging in age from 3 to 16 years, with an average age of 6 years. Of the 36 total participants, 58% were classified on the autism spectrum: 16 participants were diagnosed with autism, 2 with autism and mental retardation (MR), 1 with pervasive development disorder–not otherwise specified (PDD-NOS), and 2 with PDD-NOS and MR. Additionally, 6 participants were diagnosed with a developmental disability, 4 participants were diagnosed with MR, 2 with MR and cerebral palsy, and 3 with MR and Down syndrome. Researchers noted IQs for 9 of 36 participants (25%), all of whom had IQs below 50.

**Communication abilities.** Most of the studies described the participants’ modes of communication and/or levels of verbalization prior to each study. For comparison, the participants were characterized as producing no speech, producing limited vocalizations or imitated words, having a small repertoire of spontaneous words used functionally, or communicating effectively using alternative communication devices. Of the 36 participants, 17 (47%) were described as having no speech and communicating through gestures, reaching, or pointing (Bock, Stoner, Beck, Hanley, & Prochnow, 2005; Chambers & Rehfeldt, 2003; Frea, Arnold, & Vittimberga, 2001; Sigafoos, Ganz, O’Reilly, Lancioni, & Schlosser, 2007; Son, Sigafoos, O’Reilly, & Lancioni, 2006; Stoner et al., 2006, Yokoyama, Naoi, & Yamamoto, 2006). Eleven participants (31%) were described as being able to produce nonword vocalizations or imitate words when prompted (Chambers & Rehfeldt, 2003; Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Son et al.; Tincani, 2004; Tincani, Crozier, & Alazetta, 2006; Yokoyama et al., 2006). Four participants (11%) were described as having a small repertoire of words without prompts to communicate (Chambers & Rehfeldt, 2003; Charlop-Christy et al., 2002; Kravits, Kamps, Kemmerer, & Potucek, 2002; Stoner et al., 2006). Four participants (11%) were described as demonstrating functional communication using alternative communication devices, specifically a simple picture-exchange system (Buckley & Newchok, 2005).

### Table 2. Methodological Components

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Design(s)</th>
<th>Interobserver Agreement</th>
<th>Procedural Integrity</th>
<th>Social Validity</th>
<th>Maintenance</th>
<th>Generalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buckley &amp; Newchok (2005)</td>
<td>Reversal</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Chambers &amp; Rehfeldt (2003)</td>
<td>Alternating treatment: PECS and sign language</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Novel settings</td>
</tr>
<tr>
<td>Charlop-Christy, Carpenter, Le, LeBlanc, &amp; Kellet (2002)</td>
<td>Multiple baseline across participants</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Novel persons, settings, and objects</td>
</tr>
<tr>
<td>Frea, Arnold, &amp; Vittimberga (2001)</td>
<td>Multiple baseline across settings</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Kravits, Kamps, Kemmerer, &amp; Potucek (2002)</td>
<td>Multiple baseline across settings</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Marckel, Neef, &amp; Ferreri (2006)</td>
<td>Multiple baseline across descriptor classes</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
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<tr>
<td>Sigafoos, Ganz, O’Reilly, Lancioni, &amp; Schlosser (2007)</td>
<td>Multiple probe across participants</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
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<tr>
<td>Son, Sigafoos, O’Reilly, &amp; Lancioni (2006)</td>
<td>Alternating treatment: PECS and VOCA</td>
<td>Y</td>
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<td>N</td>
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<tr>
<td>Stoner et al. (2006)</td>
<td>ABAB</td>
<td>Y</td>
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<td>N</td>
<td>N</td>
<td>Probes with novel persons and settings</td>
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<td>Tincani, Crozier, &amp; Alazetta (2006)</td>
<td>Multiple baseline across participants; ABAB</td>
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<td>Y</td>
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<td>N</td>
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<tr>
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<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Novel persons</td>
</tr>
</tbody>
</table>

Note: PECS = Picture Exchange Communication System; VOCA = Voice Output Communication Aid.
or PECS (Marckel, Neef, & Ferreri, 2006; Tincani et al., 2006). Thirty-two participants (89%) had no exposure to PECS prior to participating in these studies. One participant had previously been trained to use PECS but was only taught a single word (Yokoyama et al., 2006). Additionally, one participant had mastered the first three phases of PECS (Tincani et al., 2006), and two participants had mastered the first four phases of PECS (Marckel et al., 2006) prior to the study.

**Settings**

Of the 13 studies, 8 (62%) were conducted in school settings. Studies were conducted in special education classrooms (Sigafoos et al., 2007; Tincani, 2004; Tincani et al., 2006), general education classrooms (Frea et al., 2001), special education and general education classrooms (Bock et al., 2005), or empty classrooms or observation rooms (Buckley & Newchok, 2005; Chambers & Rehfeldt, 2003). One of the three participants in the Yokoyama et al. (2006) study received services in a room at a university.

Some studies were conducted in home or mixed settings. Four studies were conducted in participants’ homes (Marckel et al., 2006; Son et al., 2006; Yokoyama et al., 2006) or group homes (Stoner et al., 2006). One study was conducted in both a home and a school setting (Kravits et al., 2002), and another study was conducted in home, school, and university settings (Charlop-Christy et al., 2002).

**Baseline**

In 11 of the 13 studies (85%), participants had access to pictures and desired items during baseline. Researchers in one study did not make pictures available during baseline (Buckley & Newchok, 2005), and researchers in another study did not specify baseline conditions (Charlop-Christy et al., 2002). VOCA were also available during baseline in comparison studies (Bock et al., 2005; Son et al., 2006).

**Intervention**

**Training.** Descriptions of the length and intensity of training sessions varied considerably among the studies. Researchers in a few studies provided extensive details, such as the length of sessions, number of sessions per day, number of sessions per week, amount of time between sessions, and number of trials per session (e.g., Chambers & Rehfeldt, 2003; Yokoyama et al., 2006). However, in a majority of studies, training sessions were not described in sufficient detail to be compared between studies.

**PECS phases.** Of the 13 studies, researchers in only 2 studies (15%) attempted to implement all six phases of PECS (Charlop-Christy et al., 2002; Yokoyama et al., 2006). All of the participants in 1 study (Buckley & Newchok, 2005) and one participant from the Tincani et al. (2006) study were taught PECS Phases 1 and 2. Participants in 5 studies were taught PECS Phases 1 through 3 (Bock et al., 2005; Chambers & Rehfeldt, 2003; Frea et al., 2001; Kravits et al., 2002; Tincani, 2004). Participants in Stoner et al. (2006) and one participant in Tincani et al. (2006) were taught phases 1 through 4. The third participant in the Tincani et al. study (2006) and the participant in the Marckel et al. (2006) study were trained in the fourth and fifth phases of PECS, respectively, because they demonstrated mastery of previous PECS phases from prior training.

Researchers reported that 34 of 36 participants (94%) successfully mastered the PECS phases targeted in the 13 studies. In a majority of the studies, criteria for mastery of individual PECS phases was set at 80% or above. Only two participants in the Stoner study (2006), both diagnosed with mental retardation, did not complete their target phases. One participant had difficulty manipulating pictures on the Velcro strip during Phase 2 and showed an inability to discriminate between pictures of preferred and nonpreferred objects during a brief training in Phase 3. The other participant experienced increased seizures during training for Phase 3. The participant showed a reduction in accuracy, appeared disoriented, and had tremors in her arms. The researchers resumed training in Phase 1, but the participant was not able to regain mastery of any phase.

**Modifications.** Investigators in several studies modified the original PECS procedures (Frost & Bondy, 1994). PECS interventions in three studies enhanced the listeners’ vocalizations upon exchange by using a phrase (Frea et al., 2001), sentence (Chambers & Rehfeldt, 2003), or tapping a tabletop during each syllable while saying an object’s name (Yokoyama et al., 2006). Tincani (2004) used progressive time delay, up to 4 seconds, in the third phase of PECS for one participant before delivering the requested object to allow time for the participant to vocalize the name of the object. Buckley and Newchok (2005) used a fixed-ratio reinforcement schedule in the first and second PECS phases and delivered objects every third time they were requested. Marckel et al. (2006) removed pictures of preferred items from a participant’s existing PECS book and replaced them with descriptors to encourage the participant to request a red ball by asking for a “red circle.” The researchers in two studies provided preferred objects and PECS materials in play sessions following PECS training sessions (Charlop-Christy et al., 2002; Kravits et al., 2002). Three studies did not make any modifications to the standard PECS protocol (Bock et al., 2005; Stoner et al., 2006; Tincani et al., 2006).

What Is the Effectiveness of PECS Interventions in Enhancing Communication Skills?  

**Picture exchange.** The overall effectiveness of PECS included all dependent variables, such as exchanges, speech,
or problem behaviors, that increased or decreased during PECS training. For studies with one dependent variable measured during PECS training, the PND value of that dependent variable represents the overall effectiveness of the PECS intervention. For studies with more than one dependent variable, overall effectiveness was calculated by averaging the PND values for all dependent variables measured during PECS training. In terms of overall effectiveness, PECS was a highly effective intervention for 19 of 35 participants (54%) in the 13 studies. The intervention was moderately effective for 10 of 35 participants (29%), minimally effective for 6 of 35 participants (17%), and showed no effect for 1 participant (3%). PNDs could not be calculated for 1 participant in the Yokoyama et al. (2006) study because baseline was not available. Further analysis indicates that PECS increased functional communication across age groups, disabilities, and different communication levels.

**PECS versus other interventions.** Researchers in four studies compared PECS to other interventions (Bock et al., 2005; Chambers & Rehfeldt, 2003; Tincani, 2004; Son et al., 2006). Researchers in two studies with a total of six participants compared PECS and sign language interventions to mand for items not in view (Chambers & Rehfeldt, 2003) and to demonstrate motor imitations, mands, and vocalizations (Tincani, 2004). PECS was highly effective for five of six participants and moderately effective for one participant. However, sign language was highly effective for two participants, moderately effective for one participant, minimally effective for two participants, and showed no effect for one participant. Thus, PECS appears to be a more effective intervention than sign language to increase manding in a majority of the participants.

Researchers in two other studies with a total of nine participants compared PECS and VOCA interventions to increase mands (Bock et al., 2005; Son et al., 2006). PECS was highly effective for three of nine participants, moderately effective for four participants, and minimally effective for two participants. VOCA was highly effective for two participants, moderately effective for five participants, and minimally effective for two participants. Thus, PECS appears to be as effective as VOCA to increase mands in most of the participants.

**To What Extent Does PECS Increase Speech?**

Researchers in five studies for a total of 10 participants targeted increases in speech through PECS intervention (Charlop-Christy et al., 2002; Kravits et al., 2002; Tincani, 2004; Tincani et al. 2006; Yokoyama et al., 2006). For speech increases, PECS was highly effective for 2 of 10 participants, was moderately effective for 2 participants, minimally effective for 2 participants, and showed no effect for 1 participant. For the 3 participants in Yokoyama et al. study, PNDs could not be calculated for speech because of uninterpretable data. Researchers in two of the five studies reported general increases in word vocalizations at school (Tincani, 2004) and at both home and school (Kravits et al., 2002). Yokoyama et al. (2006) recorded increased word approximations during PECS training and increased use of nonword vocalizations during free play. Researchers in two other studies found considerable increases in speech during the later phases of PECS. For example, Tincani et al. (2006) found that two of three participants increased vocalizations during Phase 4. Charlop-Christy et al. (2002) recorded increased spontaneous and imitative speech in academic and play settings during PECS Phases 4 and 5.

**To What Extent Does PECS Reduce Problem Behaviors?**

Researchers in three studies targeted problem behaviors for a total of five participants (Buckley & Newchok, 2005; Charlop-Christy et al., 2002; Frea et al., 2001). To decrease problem behaviors, PECS was a highly effective intervention for one of four participants, moderately effective for two participants, and minimally effective for one participant. Participants in two studies demonstrated decreased or eliminated aggression (Buckley & Newchok, 2005; Frea et al., 2001). Participants in Charlop-Christy et al. (2002) showed decreased problem behaviors (e.g., tantrums, grabbing, out of seat, throwing objects) in both academic and play settings.

**To What Extent Do Skills Learned Through PECS Generalize to Untrained Persons, Settings, or Behaviors?**

Researchers in 7 of 13 studies (54%) reported generalization of the PECS intervention. Participants exchanged pictures with novel listeners (Bock et al., 2005; Tincani, 2004; Tincani et al., 2006), including the participants’ parents (Yokoyama et al., 2006); in untrained home settings (Chambers & Rehfeldt, 2003); and both with novel listeners and in untrained settings, such as fast-food restaurants (Stoner et al., 2006). One study showed a broad range of generalization to novel listeners, untrained settings, and untrained objects (Charlop-Christy et al., 2002). Additionally, one study offered anecdotal evidence of generalization to novel objects (Marckel et al., 2006).

**To What Extent Is PECS a Socially Valid Intervention?**

Researchers in 2 of 13 studies (15%) reported social validation of PECS by parents and teachers. Tincani (2004) reported that the teacher found PECS to be a useful tool that could be easily implemented in her classroom. The parent of one child in the study believed that PECS increased his child's...
communication skills, whereas the parent of another child felt that PECS did not increase her child’s efforts to communicate. Marckel et al. (2006) anonymously surveyed parents and teachers on the overall social validity of PECS and reported means ranging from 7.0 and 9.5 on a scale from 1 (low) to 10 (high). Anecdotally, Stoner et al. (2006) reported that the participants themselves appeared to be highly motivated to use PECS and noted that PECS increases self-determination skills through choice making.

To What Extent Are the PECS Single-Subject Studies Methodologically Rigorous?

Researchers in 6 of 13 studies (46%) used multiple-baseline or multiple-probe designs. Investigators in 4 studies (31%) used alternating treatment designs, and ABAB designs were used in 2 studies (15%). Tincani et al. (2006) used both multiple-baseline and ABAB designs for a multiphase study. Researchers in all 13 studies (100%) collected and calculated interobserver agreement. However, researchers in only 5 studies (38%) tracked and reported procedural integrity (Bock et al., 2005; Marckel et al., 2006; Sigafoos et al., 2007; Tincani, 2004; Tincani et al., 2006). Researchers in 3 studies (23%) assessed maintenance of the PECS intervention over time (Charlop-Christy et al., 2002; Sigafoos et al., 2007; Yokoyama et al., 2006). For more details, please refer to Table 2.

Discussion

Results indicate that PECS has been highly or moderately effective for 29 of 36 participants with developmental disabilities in increasing functional communication skills. Some participants that used PECS increased speech as well as non-verbal manding. Results also indicate that in four participants the PECS intervention appears to be more effective than sign language to increase mands. Furthermore, PECS might decrease problem behaviors in some individuals with limited or no communication. Results and directions for future research and implications for practice are discussed.

PECS might be an effective tool to teach functional communication to individuals with autism because key features of PECS, such as concrete visuals and preferred reinforcers, build on the strengths of individuals with autism. Charlop-Christy et al. (2002) concluded that the success of PECS was because of its structured, concrete format and the use of picture cards as visual prompts. It is evident from the literature that individuals with autism learn better when information is concrete and presented visually (Quill, 1995), which might contribute to a greater retention of skills over time (Preis, 2006). In addition to Charlop-Christy et al.’s conclusion that the concrete structure and visual prompts contributed to the success of PECS, Ganz and Simpson (2004) recognized the power of using preferred items as reinforcers. Future researchers should conduct formal preference and reinforcer assessments (see Cooper, Heron, & Heward, 2007) and explore how manipulating symbol, referent, and instructional variables affects acquisition of pictures during PECS training (see Koul et al., 2001).

Consistent with applied behavior analysis practices, PECS uses repeated practice, modeling, prompting, error correction, fading, and so forth (Bondy & Frost, 2002). Using these proven practices might have improved participants’ communication skills. Additionally, PECS might be a successful intervention because it relies on motivating operations (increasing the value of reinforcers) that are likely to increase communication behaviors of individuals with developmental disabilities.

When compared to other interventions, such as sign language, PECS appears to be a more effective intervention (Chambers & Rehfeldt, 2003; Tincani, 2004). Chambers and Rehfeldt (2003) theorized that PECS can be regarded as a recognition task, whereas signs can be regarded as a recall task, and concluded that recognition tasks might be easier for individuals with impaired cognitive functioning. These findings indicate that PECS training might generalize more easily than sign language training, especially during Phase 3, when pictures of multiple objects in the PECS binder remind participants to mand for available objects that might be out of view.

PECS, however, appears to be as effective as VOCA in the reviewed studies, a finding consistent with results from Lancioni et al. (2007). A possible explanation might be the similarities between VOCA and PECS systems in terms of mode of communication, use of pictures, training strategies, and use of natural reinforcers. Future researchers should investigate the effectiveness of individual components of PECS and VOCA and their influence on communication skills in persons with developmental disabilities.

PECS increased speech in very few participants, specifically 4 of 10 participants in the five studies that targeted speech. Results from three of the five speech studies—the only three studies that taught participants all six phases of PECS—support the theory that Phase 4 of PECS has the greatest potential to promote speech (Charlop-Christy et al., 2002; Tincani et al., 2006; Yokoyama et al., 2006). Because researchers in majority of the studies in this review did not teach all six phases of PECS, it remains unclear whether PECS might increase speech in other individuals with developmental disabilities. Future researchers should train participants through Phase 4 or beyond to examine how the advanced stages of PECS, building sentences through pictures, might contribute to speech development.

Inconsistencies across the 13 studies in the review indicate that reported increases in speech might not accurately reflect changes in the participants’ use of speech after receiving the PECS intervention. First, 8 of 13 studies did not target and collect speech-related data. Second, researchers in most studies provided limited data on the participants’ level of speech...
production during baseline. Researchers differed in the extent to which they evaluated and described the participants’ speech levels and used a variety of terms to describe speech, including language, verbalizations, and vocalizations. Future research is needed to develop a profile of participant characteristics, such as cognitive level, age, and disability, that might predict gains in speech during PECS training.

PECS not only increased communication behaviors but also decreased problem behaviors in some participants in three studies that targeted problem behaviors (Buckley & Newchok, 2005; Charlop-Christy et al., 2002; Frea et al. 2001). These findings support assertions that problem behaviors are often attempts to communicate and that functional communication can replace less acceptable modes of communication (Carr & Durand, 1985; Scott et al., 2000). However, because of the small number of studies, effectiveness of PECS to decrease problem behaviors in persons with disabilities should be viewed as tenuous until enough evidence is gathered to make such conclusions.

Researchers in 7 of 13 studies reported generalization of the PECS intervention to novel listeners, in untrained settings, or to untrained objects. It is possible that the use of highly preferred objects and activities in PECS might have increased communication attempts. Furthermore, exchange of preferred objects and activities in natural environments by the participants might have enhanced generalization of communication behaviors. Future research should continue to investigate generalization of PECS exchanges in natural settings, particularly with typical peers.

Out of 13 studies, investigators in only 2 studies reported on the social validity of PECS (Marcel et al., 2006; Tincani, 2004). PECS has the potential to have high social validity because it is portable; is inexpensive compared to VOCA; and can be easily understood by untrained persons, unlike sign language. Future researchers might want to investigate the feasibility of using PECS in social settings or with typical peers.

In terms of rigor, the studies in this review have strengths and weaknesses. The studies used a range of experimental designs to demonstrate a functional relationship between independent and dependent variables. However, methodological improvements called for by Odom et al. (2003), Simpson (2005), and other researchers could strengthen the results of future studies. Whereas researchers in all of the studies collected interobserver agreement, researchers in 5 of 13 studies did not report procedural integrity data, making it unclear whether trainers in these studies implemented the intervention with fidelity. Procedural integrity helps practitioners to be knowledgeable of the positive and expected outcomes of an intervention (Simpson, 2005). Roughly half of the studies included opportunities for generalization, but very few studies assessed the social validity of PECS as an intervention. Additionally, researchers in many studies did not provide complete details of participants, such as IQ, test scores, and so forth, which limits practitioners’ abilities to determine whether PECS might meet the individual needs of students (Simpson, 2005). Future researchers are encouraged to provide detailed descriptions of participants and collect data on procedural integrity, maintenance, generalization, and social validity to meet the scientific standards set forth by leaders in the field (Odom et al., 2003).

**Limitations**

A few limitations of the study should be noted. First, because PNDs are not a true metric, using PNDs to report intervention effectiveness might tend to exaggerate results (Banda & Therrien, 2008). However, the PND method is commonly used in research and is one of the most accepted methods to conduct meta-analyses on single-subject design studies (Scruggs & Mastropieri, 2001). Second, the PECS intervention might have additional support from group experimental studies, which were not included in this review. Future reviews that include both group and single-subject design studies are encouraged.

**Implications for Practitioners**

PECS can increase a student’s ability to function and communicate in the classroom (Scott et al., 2000; Sigafouos, 2005). PECS can be used with students with limited communication abilities and does not require prerequisite skills, such as eye contact, matching, or motor and verbal imitation skills. This review indicates potential success with students who are in prekindergarten or elementary school, have little to no functional speech, and have no prior experience with PECS. However, practitioners should be cautious about generalizing the results of this review to the population of developmental disabilities because of the small number of participants, the broad range of participant characteristics, and variations in instructional procedures in the PECS literature. Because each student progresses at his or her own rate, practitioners should begin to use intervention as early as possible to allow the student to reach the advanced PECS phases where gains in speech might be achieved. Practitioners should also learn to systematically identify powerful reinforcers to implement PECS with success. In addition, practitioners should seek training to be able to follow PECS protocol (Bondy & Frost, 2001a) and continually document student progress (Frost & Bondy, 1994). Practitioners should consider tracking behaviors, such as increases in speech and social skills and decreases in problem behaviors, in addition to tracking progress in each PECS phase. As with any intervention, parent and professional teams should collaboratively compare intervention methods and consider the risks or benefits of choosing one intervention over another (Simpson, 2005).
Conclusions

In summary, PECS may increase manding, social-communicative behavior, and speech and decrease problem behaviors. More research is needed to determine if the use of PECS is feasible in inclusive settings and with varied age groups, particularly with adolescents. Further research that includes maintenance over several years, generalization beyond training conditions, integrity procedures, and social validity measures are necessary to produce rigorous studies that add to the evidence base and allow researchers and practitioners to realize the full potential of the PECS intervention.

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**About the Authors**

Stephanie L. Hart, MEd, is a doctoral student in special education in the Department of Educational Psychology & Leadership at Texas Tech University. Her research interests include autism and behavioral interventions.

Devender R. Banda, PhD, BCBA, is an assistant professor of special education in the Department of Educational Psychology & Leadership at Texas Tech University. His research interests include social and behavioral interventions for students with autism.