THE EFFECTIVENESS OF COMBINING TANGIBLE SYMBOLS WITH
THE PICTURE EXCHANGE COMMUNICATION SYSTEM TO TEACH
REQUESTING SKILLS TO CHILDREN WITH MULTIPLE DISABILITIES
INCLUDING VISUAL IMPAIRMENT

by

Emad Ali

A Dissertation Submitted to the Faculty of the
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2009
THE UNIVERSITY OF ARIZONA

GRADUATE COLLEGE

As members of the Dissertation Committee, we certify that we have read the dissertation prepared by Emad Ali entitled The Effectiveness of Combining Tangible Symbols with the Picture Exchange Communication System to Teach Requesting Skills to Children with Multiple Disabilities including Visual Impairment and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy.

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I hereby certify that I have read this dissertation prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

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Dissertation Co-Chair: Dr. John Umbreit, Ph. D.

___________________________________________________ Date: May 12, 2009
Dissertation Co-Chair: Dr. Stephanie MacFarland, Ph. D.
STATEMENT BY AUTHOR

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SIGNED: *Emad Ali*
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DEDICATION

To my parents, whose encouragement was the first motivation for me to continue my studies. To them, my appreciation is truly beyond words.

To my lovely sisters, Wafaa and Asmaa, I have special respect for both of them for their continuous encouragement throughout my studies.

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ABSTRACT

The Picture Exchange Communication System (PECS) is an augmentative and alternative communication program (Frost & Bondy, 2002). Although PECS has been effectively used to teach functional requesting skills for children with autism, mental retardation, visual impairment, and physical disabilities (e.g., Anderson, Moore, & Bourne, 2007; Chambers & Rehfeldt, 2003), there are limited studies examining the effectiveness of PECS to teach requesting skills for children with multiple disabilities including visual impairment (Lund & Troha, 2008).

This study explored the effectiveness of combining tangible symbols and other adaptations with PECS to teach requesting skills to students with multiple disabilities. Specifically, the participants were four students with multiple disabilities including visual impairment who also had many challenges in communication skills. The research design was the multiple probe design across subjects, a variation of a multiple baseline design. A notable benefit to this design is that there was no need to collect continuous recordings of baseline measures, because a strong a priori assumption of stability and the possibility of causing strong participant reactions existed before introducing the intervention. Instead, the researcher made periodic recordings of baseline levels to insure no significant changes have occurred before introducing the intervention.

The study included four parts: (a) the assessment of reinforcers, (b) baseline, (c) the implementation of the intervention, which was teaching the three PECS phases and conducting generalization sessions, and (d) the maintenance condition. Three important research questions were posed:
1. Can students with multiple disabilities including visual impairment learn to make requests for preferred items using adapted PECS materials and procedures?

2. Can students with multiple disabilities including visual impairment generalize requesting skills for preferred items using adapted PECS from training rooms to classrooms?

3. Can students with multiple disabilities including visual impairment maintain requesting skills after training?

The results indicated that all four participants learned requesting skills using adapted PECS, generalized the newly acquired skills to their classrooms, and maintained the requesting skills after training. Results of this study provided preliminary evidence that PECS with adaptations could be used effectively to teach requesting skills for students with multiple disabilities including visual impairment.
CHAPTER 1
INTRODUCTION

Communication is a crucial aspect of life. Through communication, people can request their needs, share their values and interests, and make relationships with each other (Stoner, Beck, Bock, Hickey, Kosuwan, & Thompson, 2006). Bondy (2001) identified functional communication as directed behavior from one person to another who provides a response that could be some form of reinforcement. However, people with multiple and cognitive disabilities have limitations in their language that make it difficult for them to understand others, to request their needs, or to respond to others’ communications (Snell, Chen, & Hoover, 2006).

In many studies, researchers support that people with autism, or multiple and cognitive disabilities can benefit from intervention programs to increase communication and social skills (Snell et al., 2006). Interventionists should work together to collect empirical data in order to support the use of any intervention communication program for children with severe and multiple disabilities (Bock, Stoner, Beck, Hanley, & Prochnow, 2005).

Augmentative and alternative communication (AAC) is “A system of communication services for individuals who do not depend on speech for the majority of their communicative interactions” (Downing, 2005b, p. 135). Individuals with severe cognitive disabilities can learn to request or reject things by using AAC programs such as sign language, pointing to or touching pictures, or operating voice-output communication.
devices (Snell et al., 2006). One of the communication programs that is used for children with autism and cognitive disabilities is the Picture Exchange Communication System (PECS) (Stoner et al., 2006). PECS consists of six phases, beginning with the exchange of a single picture for a preferred item and ending with making requests and comments by using sentences that may utilize many pictures (Bondy, 2001).

PECS is an augmentative and alternative communication program that was designed for children who are non-verbal or have very little speech (Bondy, 2001). The idea of PECS was created in response to the concerns about other teaching strategies in which learners are highly dependent on prompting and imitating behaviors as pre-requisite skills. For example, in sign language, children need to imitate signs made by an educator. In another alternative communication such as pointing to or touching pictures/symbols, children need to first learn how to match pictures to objects or objects to pictures before learning communication (Frost & Bondy, 2002). However, for learning PECS, children do not need to have imitation and eye contact skills as pre-requisite skills. One of the concerns about other communication programs is that children communicate only when they are prompted. Therefore, PECS was created to let learners initiate communication with other persons in order to acquire functional communication skills (Bondy, 2001).

The rationale of PECS is that the exchange of a picture for a preferred item parallels the communicative exchange that takes place in typical conversations (Bondy & Frost, 1993, 1994). PECS is based on the theory and practices of both behavioral and developmental perspectives (Bondy & Frost, 2001). In typical language learning
processes, children learn to communicate before they learn to say specific words.
Likewise with PECS, children learn how to communicate before they learn to
discriminate between pictures or symbols in order to provide specific messages (Frost & Bondy, 2002). PECS was also influenced by Skinner’s framework in which the verbal
behavior of the speaker is under the stimulus control of the listener whose role is to
mediate reinforcement (Bondy, 2001). Furthermore, PECS training is based on the
research of applied behavior analysis. For example, reinforcement strategies, error
correction, and generalization strategies are addressed in teaching communication skills
using PECS (Frost & Bondy, 2002).

PECS was effectively implemented to teach functional communication skills for
children with Autistic Spectrum Disorders (ASD) and other developmental disabilities
(Bock et al., 2005; Chambers & Rehfeldt, 2003; Schwartz, Garfinkle, & Bauer, 1998;
Tien, 2008). For example, Schwartz et al. analyzed the PECS acquisition data for 31
preschool children with autism and other developmental disabilities. These researchers
demonstrated that the children could learn functional communication quickly and
efficiently skills using PECS.

Although PECS was originally created to teach a quick and functional
communication system to children with autism and other social communicative disorders
(Bondy, 2001), PECS was also effectively implemented to teach communication skills to
individuals with cognitive and physical disabilities (Bock et al., 2005; Lund & Troha,
2008; Stoner et al., 2006). For example, Stoner et al. taught PECS to five adults with
mental retardation. The researchers indicated that three participants improved their
communication skills significantly and that they could generalize the communication skills to their homes and communities.

Some researchers made adaptations to PECS to be more easily used by children with disabilities, such as those with physical disabilities (Almeida, Piza, & Lamonica, 2005; Ganz, Cook, Corbin-Newsome, Bourgeois, & Flores, 2005). For example, Almeida et al. (2005) adapted the PECS’s materials to be more easily used by a 10 year old child with cerebral palsy and athetoid quadriplegia. Almeida et al. (2005) used a wooden board to mount the pictures instead of using a folder or a binder as in typical PECS. Almeida et al. (2005) indicated that the participant passed through all five PECS phases, and used the communication board in school activities.

One research study examined teaching PECS to students with multiple disabilities and visual impairment (Lund & Troha, 2008). Lund and Troha made certain adaptations to standard PECS for three students aged 12 years and older. The participants were students with cognitive disabilities, autism, and blindness. Instead of using pictures as in standard PECS, Lund and Troha used tangible symbols with three dimensions to be easily used by the participants. Lund and Troha indicated that one of the three participants completed the communication program successfully and the other two participants did not meet the standards for success in the various phases, and thus not did complete the program. All participants did exhibit improvement in their performances between the baseline and the intervention phases.

Lund and Troha (2008) provided preliminary results supporting the use of tangible symbols with adapted strategies from PECS to teach requesting skills to
individuals with visual impairments and cognitive disabilities. They recommended further research to be conducted on the use of PECS to teach requesting skills to individuals with multiple disabilities including visual impairment.

Statement of the Problem

Lund and Troha (2008) provided initial evidence about the effectiveness of combining tangible symbols and strategies from PECS to teach requesting skills to students with multiple disabilities including blindness, mental retardation, and autism. They recommended conducting other studies to evaluate the effectiveness of combining tangible symbols with strategies from PECS to teach communication skills to children with multiple disabilities and visual impairments. The purpose of this study is to expand the use of PECS to students with multiple disabilities including visual impairment by combining tangible symbols and adapted strategies from PECS.

Research Questions

In this study, the researcher expanded the use of PECS to teach requesting skills to students with multiple disabilities including visual impairment. The specific questions addressed in this study were

1. Can students with multiple disabilities including visual impairment learn to make requests for preferred items using adapted PECS materials and procedures?
2. Can students with multiple disabilities including visual impairment generalize requesting skills for preferred items using adapted PECS from training rooms to classrooms?

3. Can students with multiple disabilities including visual impairment maintain requesting skills after training?
CHAPTER 2
REVIEW OF THE LITERATURE

Research Method

Search Terms

To search for relevant studies, the following key words were used:

1. Picture Communication Exchange System
2. PECS

Sources

The Psychological Abstracts (PsycINFO), and Educational Resources Information Center (ERIC) were the primary information databases chosen for study searches. In addition, Google search engine was used to searching for other relevant studies.

The reference lists of any research studies were also reviewed. Various PECS research studies, “PECS Related Publications”, were found on the website of Pyramid Educational Consultants that are considered the source of PECS, www.pecs.com, and also were reviewed.

Using the service of Inter-library Loan (ILL) at the library of the University of Arizona and contact with Pyramid Educational Consultants enabled the author to retrieve full texts of some research studies that were unavailable in mentioned databases.
Selection Criteria

The final selection of studies met the following criteria:

1. The focus of the study was to measure the effectiveness of PECS, or PECS with adaptations;
2. The focus of the study was to improve functional communication skills;
3. One or more of the outcomes of the study was to assess requesting, or manding skills;
4. The study examined exchanging skills, initiating communication, or assessing the use of PECS; and
5. The study was written in the English language.

PECS Studies

Based on the selection criteria, 23 studies with a total of 132 participants were reviewed (See Table 1). In the 23 studies reviewed, the authors measured the effectiveness of PECS on teaching requesting skills and other communication skills for individuals with disabilities. Based on information in the studies reviewed, researchers provided a degree of evidence that PECS was effective to teach functional requesting skills for children with Autistic Spectrum Disorders (ASD), mental retardation, and severe and multiple disabilities (Anderson, Moore, & Bourne, 2007; Chambers & Rehfeldt, 2003; Lund & Troha, 2008; Schwartz et al., 1998).

Among the 132 participants in the studies reviewed, two participants were removed from the studies because of their illnesses. The authors of the 23 reviewed
<table>
<thead>
<tr>
<th>Authors</th>
<th>N &amp; age</th>
<th>Diagnosis</th>
<th>Communication consequences.</th>
</tr>
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<tbody>
<tr>
<td>1. Adkins &amp; Axelrod (2002)</td>
<td>One participant Age: 7 years old</td>
<td>Pervasive Developmental disorder and ADHD</td>
<td>Using alternative treatment design, authors compared PECS and sign language while teaching requesting preferred items. The authors indicated that the number of trials to meet the study criterion was less with PECS than with sign language and PECS was more spontaneously used than sign language.</td>
</tr>
<tr>
<td>2. Almeida, Piza, Lamonica (2005)</td>
<td>One participant Age: 9 years old</td>
<td>Moderate Mental Retardation, Quadriplegic Athetoid Cerebral Palsy, and Estropia</td>
<td>Using an AB design, the authors adapted PECS in materials and procedures to be appropriate for a participant with cerebral palsy. The authors indicated that the participant mastered the adapted five PECS phases that were taught during the study.</td>
</tr>
<tr>
<td>3. Anderson, Moore, &amp; Bourne (2007)</td>
<td>One participant 6 years old</td>
<td>Autism</td>
<td>The first four phases of PECS were taught to one participant with autism. The effectiveness of PECS on teaching mand (request) skills, verbal initiations, and cumulative words spoken was assessed. The authors indicated that PECS skills were acquired easily by the participant. In addition, the participant increased verbal initiations, cumulative words spoken, and playing time.</td>
</tr>
<tr>
<td>4. Beck, Stoner, Bock, &amp; Parton (2008)</td>
<td>4 participants Pre-school age (as Mentioned)</td>
<td>Two students, Autism; One student, speech impairment; one student, Pervasive Developmental Disorder.</td>
<td>Using alternative treatment design, the authors indicated that PECS skills were more easily acquired by the participants than VOCA (Voice Output Communication Aide) skills. The authors also indicated that the influence of PECS and VOCA on verbalizations was different for each participant.</td>
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#### Studies Table

<table>
<thead>
<tr>
<th>Study Reference</th>
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<th>Diagnosis</th>
<th>Design</th>
<th>Treatment</th>
<th>Outcome</th>
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<td>5. Bock, Stoner, Beck, Hanley, &amp; Prochnow (2005)</td>
<td>6 pre-schoolers</td>
<td>Developmental Delay</td>
<td>Alternative treatment design</td>
<td>PECS vs. VOCA, GOTAIK device</td>
<td>PECS acquired at slightly higher rate, 3 of 6 preferred PECS, 2 preferred VOCA, 1 no preference</td>
</tr>
<tr>
<td>6. Chambers &amp; Rehfeldt (2003)</td>
<td>4 participants</td>
<td>Severe Mental Retardation</td>
<td>Alternative treatment design</td>
<td>PECS vs. Sign language</td>
<td>PECS acquired faster, all 3 demonstrated generalization across settings, 2 showed generalization skills using sign language</td>
</tr>
<tr>
<td>7. Charlop-Christy, Carpenter, Le, LeBlanc, &amp; Kellet (2002)</td>
<td>3 students</td>
<td>Autism</td>
<td>Alternative treatment design</td>
<td>PECS</td>
<td>Mastered 6 PECS phases, increased verbal speech skills and social communication behaviors</td>
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The authors investigated the effectiveness of PECS on mastering the requesting and commenting skills using PECS. The authors indicated that the three participants mastered the 6 PECS phases. In addition, the participants increased verbal speech skills and social communication behaviors, other dependent variables measured in the study.
Table 1 (*continued*)

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<td><strong>8. Charlop, Malmberg, &amp; Berquist (2008)</strong></td>
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<td><strong>9. Finkel, Weber, &amp; Derby (2004)</strong></td>
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<td><strong>10. Ganz, Cook, Corbin-Newsome, Bourgeois, &amp; Flores (2005)</strong></td>
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<th>Sample Description</th>
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<th>Study Description</th>
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<td>11. Ganz &amp; Simpson (2004)</td>
<td>3 students, Ages: 3, 5, and 7 years old</td>
<td>ASD and Developmental delays</td>
<td>The authors investigated the effectiveness of PECS on teaching independent PECS exchanges and word utterances. Three participants who were taught the first four PECS phases mastered PECS skills and increased word utterances.</td>
</tr>
<tr>
<td>12. Heneker, &amp; Page (2003)</td>
<td>N: not mentioned Group 1: 6 to 8 years Group 2: 9-10 years</td>
<td>Autism</td>
<td>The effectiveness of teaching the six phases of PECS for two groups of students with autism was investigated. Authors indicated that the use of PECS for requesting and commenting was increased significantly during follow-up phase comparing with the baseline phase. In addition, requesting was the most frequent function of communication and the presence of an object/want was the main level of stimulus to which children responded.</td>
</tr>
<tr>
<td>13. Kravits, Kamps, Kemmerer, &amp; Potucek (2002)</td>
<td>One student, Age: 6 years</td>
<td>Mental Retardation and Autism</td>
<td>Using a <em>multiple baseline across settings</em> design, one participant was taught phases 1-111 in two settings, home and school. The authors indicated that the mean frequency of the use of PECS pictures for communication, intelligible verbalizations, and the mean duration of social interaction with peers were increased significantly and consistently across home and school.</td>
</tr>
<tr>
<td>14. Liddle (2001)</td>
<td>21 children, Age: not mentioned</td>
<td>14 students, Autism 7 students, Severe Communication deficits</td>
<td>20 out of 21 children learned to use PECS in different phases to request desired items. Only one participant did not achieve the phase 1 of PECS. The author concluded that the use of PECS is beneficial not only to children with ASD but also to children other than autism.</td>
</tr>
<tr>
<td>Study ID</td>
<td>Participants</td>
<td>Diagnosis(s)</td>
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<td>15. Lund &amp; Troha (2008)</td>
<td>3 participants (Ages: 12, 13, and 17 years)</td>
<td>Mental Retardation, Visual Impairment, and Autism</td>
<td>PECS was adapted to be easily used by three participants who have autism, who are blind, and who are cognitively impaired. The authors indicated that only one of the three participants met the criteria of completing the three phases of adapted PECS.</td>
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<tr>
<td>16. Magiati, &amp; Howlin (2003)</td>
<td>34 students (5-12 years)</td>
<td>Autism; No or minimal spoken language</td>
<td>The six phases of PECS were taught over a 6 month period to 34 participants with ASD. The participants showed significant and rapid increases in their use of PECS, in their PECS vocabulary, and in their frequency of PECS use over time.</td>
</tr>
<tr>
<td>17. Malandraki &amp; Okalidou (2007)</td>
<td>One participant (Age: 10 -year old)</td>
<td>Autism and Deafness</td>
<td>The authors adapted the six phases of PECS in materials and procedures to be easily used by a participant with profound hearing loss and autism. The authors indicated that the participant mastered the adapted six phases of PECS.</td>
</tr>
<tr>
<td>18. Marckel, Neef, &amp; Ferreri (2006)</td>
<td>Two participants (Ages: 4 and 5 years old)</td>
<td>Autism</td>
<td>Two participants who used PECS were taught to use descriptors to request desired items while the specific pictures of the desired items were unavailable. Using a multiple baseline design across descriptors of specific pictures, the two participants increased significantly the number of independent requests and generalized request skills to novel items.</td>
</tr>
<tr>
<td>19. Rehfeldt, &amp; Root (2005)</td>
<td>3 students (Ages: 20, 27, and 34 years)</td>
<td>Severe Mental Retardation</td>
<td>Using a multiple baseline design across participants, three participants were taught the first three PECS phases. Authors indicated that all participants learned to use PECS to request items.</td>
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Studies Table

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<td>20. Schwartz, Garfinkle, &amp; Bauer (1998)</td>
<td>31 preschool participants</td>
<td>Ages: 3-6 years</td>
<td>16 participants, Autism; 15 participants, Down syndrome and Angelman’s syndrome</td>
<td>The authors analyzed the data of 31 preschool students who used PECS during the last 4 school years. Based on data collected, the authors mentioned that all students learned to use PECS system to request preferred items with adults and peers in their classrooms.</td>
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<td>21. Simon, Whitehair, &amp; Toll (1996)</td>
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<td>22. Stoner, Beck, Bock, Hickey, Kosuwan, &amp; Thompson (2006)</td>
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<td>Two participants</td>
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<td>Using alternative treatment design, the author compared PECS and sign language on teaching independent requesting skills. One participant produced higher percentage of independent mands (requests) using PECS while other using sign language.</td>
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studies indicated that 126 of 130 participants (97%) developed and improved requesting skills and other functional communication skills using PECS. For example, Schwartz et al. (1998) analyzed the data of 31 preschool students with ASD, Down syndrome and other developmental disabilities who used PECS during the last four school years. PECS acquisition data were collected using each child's IEP data that indicated the student’s first training and the progress on the PECS program for each student. All students received PECS training based on the consecutive PECS training manuals (Frost & Bondy, 1992, 1994, 1996). Based on the data collection, Schwartz et al. mentioned that all 31 preschool students learned to use the PECS system to request preferred items with adults and peers in their classrooms.

In addition, Charlop-Christy, Carpenter, Le, LeBlanc, and Kellet (2002) examined the effectiveness of PECS on mastering the PECS skills and increasing communication skills to three children with autism. The ages of the participants were three, five, and 12 years old. The participants were exposed to speech training prior to the study. However, speech training was ineffective in teaching them to communicate effectively. Therefore, PECS was chosen as an alternative communication system instead of the speech training (Charlop-Christy et al.). By using a multiple baseline design across participants, Charlop-Christy et al. indicated that all three participants met the criterion for each PECS phase of the six phases, which was 80% correct response for each phase. In addition, the three participants showed increased verbal speech associated with increased social-communicative behaviors as other dependent variables measured during the study. Charlop-Christy et al. concluded that the selection of participants was based on their need to learn communication skills and no participant was
selected based on the presence of any pre-requisite skills. Therefore, the mastering of PECS was not based on selection procedures.

Tien (2008) used a practice-based synthesis to examine 13 studies about the effectiveness of PECS for improving functional communication skills to 125 students with ASD. Among 13 studies analyzed, twelve studies were single participant designs, and one study was an analysis of archival data to examine pre-post intervention outcomes. Based on the synthesis of 13 studies, Tien concluded that all participants who received the PECS training improved functional communication skills.

Tien (2008) mentioned that some of the most commonly positive outcomes of the studies analyzed were the successful use of PECS as a communication method and the significant increase in the overall level of communication and language skills. Therefore, Tien’s research indicated that PECS is considered an evidence-based intervention for improving functional communication skills of individuals with ASD. Tien recommended further research to be conducted on implementing PECS to individuals with disabilities other than individuals with autism.

Although PECS was originally created to teach functional communication skills to children with autism and other social communicative disorders (Bondy, 2001), PECS or PECS with adaptations was also effectively implemented to teach communication skills to individuals with cognitive disabilities, physical disabilities, and severe and multiple disabilities (Almeida, Piza, & Lamonica, 2005; Chambers & Rehfeldt, 2003; Lund & Troha, 2008; Malandraki & Okalidou, 2007; Rehfeldt, & Root, 2005; Stoner et al., 2006). For example, Rehfeldt and Root (2005) used a multiple baseline design across
participants to teach the first three PECS phases to three adults with severe mental
retardation. Rehfeldt and Root indicated that all three participants learned and mastered
the first three phases of PECS. For example, during the baseline sessions, the average of
correct responses was 0% for one of the participants, while during the PECS Phase 3, the
average of correct responses was 100%.

Stoner et al. (2006) taught the first four phases of PECS to five adults with mental
retardation. By using A-B-A-B design, Stoner et al. indicated that three individuals
mastered all four phases of PECS and they could generalize the PECS skills to their
homes and communities. For example, two participants who got 0% of correct responses
during baseline sessions increased the correct responses on PECS to 100% during the
training and generalization sessions.

In addition, researchers provided a degree of evidence that PECS with adaptations
was implemented effectively to teach requesting skills for children with physical, severe
and multiple disabilities (Almeida et al., 2005; Lund & Troha, 2008; Malandraki &
Okalidou, 2007). These studies are discussed more thoroughly later in this chapter.

Comparing PECS with Other Communication Programs

Researchers also provided a degree of evidence that PECS was more effective
than other communication programs such as sign language, Voice Output
Communication Aide (VOCA), and facilitated communication in teaching requesting
skills to children with developmental disorders and severe disabilities. However,
researchers recommended further research to be conducted in comparing PECS with other communication systems (Chambers & Rehfeldt, 2003; Adkins & Axelrod, 2002).

In six of 23 studies reviewed, the researchers compared the effects of PECS with other communication programs including sign language, VOCA, and facilitated communication on teaching requesting skills for 18 participants. The authors of the six studies indicated that 17 of 18 participants (94%) acquired PECS skills faster with higher rates of acquisition than the acquisition of sign language, VOCA skills, or facilitated communication skills (Adkins & Axelrod, 2002; Beck, Stoner, Bock, & Parton, 2008; Bock, Stoner, Beck, Hanley, & Prochnow, 2005; Chamber & Rehfeldt, 2003; Simon, Whitehair, & Toll, 1996; Tincani, 2004).

Chambers & Rehfeldt (2003) investigated whether manual sign or PECS would be more effective in teaching requesting skills to four adults with severe mental retardation. An alternating treatment design was used in which each participant was taught to request the same preferred items using PECS and manual sign. Half of each training session was allocated for training each communication form with at least a five min break between manual sign and PECS training. The participants were taught the first three PECS phases with a criterion of 80% correct responses or higher in at least one training session for advancing from one phase to another.

Chambers & Rehfeldt (2003) concluded that three of four participants met the criterion performance of the study using PECS first, while only two of those three participants met the criterion performance later using manual sign. The fourth participant could not continue the training due to illness, but the participant’s data showed more
progress with PECS than with manual sign. Furthermore, Chambers and Rehfeldt (2003) mentioned that all three participants demonstrated generalization across settings using PECS while only two participants demonstrated generalization skills using manual sign. Chambers and Rehfeldt concluded that learning manual sign required more developed imitative skills than the participants could possess.

Adkins and Axelrod (2002) examined the effectiveness of PECS and American Sign Language (ASL) in teaching requesting skills to one child with a pervasive developmental disorder and ADHD. The child participant was taught to request preferred items using ASL and PECS with an alternating research design. Four types of sessions were conducted: Two training sessions for ASL and PECS, and two test sessions for the generalization of PECS and signed words. The number of trials to meet criterion and the occurrence of spontaneous emissions of the taught words were recorded. In summary, the number of trials to meet requested criterion was lower with PECS than with ASL. For example, the average number of trials to meet the criterion when training PECS words was 7.1 trials, while the average number of trials to meet criterion when training sign words was 15.7 trials. In addition, during the test for the generalization session, researchers assessed which response form, PECS or ASL, was used most often by the participant. Adkins and Axelrod (2002) indicated that the participant requested preferred items using PECS more than using sign language.

PECS was also compared with using Facilitated Communication (FC) for teaching requesting skills and for assessing the preferred mode of communication (Simon et al., 1996). Simon et al. reported a 6-month follow up of a student with ADHD and
moderate mental retardation who was taught FC using a typewriter for communication. The participant was taught to type on a keyboard the activities experienced in the participant’s school with providing a physical support and other cues by a facilitator. However, during the 6-month follow-up, FC had stopped due to the participant’s refusal to use a typewriter. Therefore, the participant was taught and encouraged to communicate using other communication programs such as PECS. When the participant was given a choice to request preferred items using FC or using PECS, PECS was the preferred mode of communication. In addition, the participant performed 100% accuracy in requesting skills using PECS, while the participant performed 0% accuracy with requesting skills using FC.

Tincani (2004) compared the effects of PECS and sign language training on the acquisition of independent requesting skills for two children with autism. By using alternating treatment design, Tincani indicated that one participant demonstrated a higher percentage of independent requests when using PECS than when using sign language. The other participant demonstrated the opposite, a higher percentage of independent requests using sign language than using PECS. Tincani concluded the acquisition of PECS and sign language may depend on motor imitation skills. The participant who demonstrated moderate motor imitation skills acquired a higher percentage of independent requests using sign language than using PECS, while the participant who demonstrated low motor imitation skills acquired a higher percentage of independent requests using PECS (Tincani). Tincani recommended further research should be
conducted to determine the most effective procedures for teaching PECS and sign language.

Tien (2008) analyzed three studies included comparing PECS against sign language. Tien indicated that the rates of acquisition in PECS were faster than the rates of acquisition in sign language and most participants preferred using PECS more than using sign language as a communication method. However, because little research was conducted in comparing PECS with sign language, Adkins and Axelrod (2002) recommended further research should be conducted to compare PECS with sign language to children with developmental disorders.

PECS with Adaptations

Stoner et al. (2006) implemented the first four phases of PECS to five adults with mental retardation. By using an A-B-A-B design, Stoner et al. indicated that three individuals mastered all four phases of PECS and they were able to generalize the PECS skills in their homes and communities. For example, two participants who got 0% of correct responses during baseline sessions increased the correct responses on PECS to 100% during the training and generalization sessions. However, two participants did not master the four PECS skills. According to Stoner et al., one of the participants who could not achieve PECS skills was not physically well, especially in the last weeks of the study, due to a seizure disorder.

Stoner et al. (2006) also mentioned that the another participant, who did not achieve PECS skills during Phase 2 and Phase 3, had motor difficulties to remove the
attached pictures with Velcro to the cover page of the communication book and to discriminate between two pictures. Therefore, because the participant made little progress during Phase 2 and Phase 3, the PECS training had been stopped with the participant. However, this participant might benefit from PECS if individualized modifications were applied to typical PECS materials or procedures (Ganz, Cook, Corbin-Newsom, Bourgeois, & Flores, 2005).

Frost and Bondy (2002) mentioned that the administrators of PECS can consult occupational therapists to make appropriate modifications on pictures to be easily used by students with physical difficulties. For example, printing a picture on a thick paper or mounting it on a block of wood and screwing a dowel into the wood to be as a handle are some modifications on pictures to be easily used by students with physical difficulties. Frost and Bondy (2002) also mentioned that different discrimination strategies can be used to teach students who have difficulties in discrimination between pictures. For example, instead of using pictures, one alternative strategy is using three-dimensional representations of the pictures to be more easily discriminated.

Several researchers provided evidence that PECS with adaptations was implemented effectively to teach requesting skills to individuals with physical disabilities, individuals with autism, individuals with visual impairment, and individuals with severe disabilities (Almeida et al., 2005; Ganz et al., 2005; Lund & Troha, 2008). For example, Ganz et al. investigated the impact of PECS on speech skills for three children with autism. One of the participants could not make independent exchanges during PECS Phase 1 as written in the PECS manual by Frost and Bondy (2002).
Therefore, Ganz et al. made adaptations to PECS materials and procedures in Phases 1 and 3 by introducing additional phases that included a hierarchy of visual representations.

In Ganz’s (2005) study, the most important adaptation was using plastic boxes including actual preferred items instead of using pictures as in typical PECS. The participant learned PECS skills first by using plastic boxes including preferred items to entice the participant to reach to and pick up the boxes. After that, a photograph of the item was attached to each plastic box, then the boxes were removed and only photographs were used. Ganz et al. indicated that the participant was able to learn Phases 1 and 3 by using a hierarchy of visual representations beginning with tangible symbols and ending with photographs. For example, during the typical Phase 1, the participant performed no more than 20% of trials independently within any session. However, during the adapted Phase 1, the participant performed 80% of trials independently in seven consecutive sessions.

Ganz et al. (2005) mentioned that because typical PECS was not successful with the participant, adaptations to PECS materials and procedures were needed. Ganz et al. concluded that the participant, like the other children with ASD and other developmental disorders, need to learn a communication system with concrete symbols first, then gradually use less tangible symbols such as photographs.

Almeida et al. (2005) also adapted the materials and procedures of PECS to be more easily used by a nine-year-old child with a moderate mental retardation, quadriplegic athetoid cerebral palsy, and estropia. The adaptation on PECS was structured to address the necessities of the child with cerebral palsy. For example,
Almeida et al. used a wooden board to mount the pictures instead of using a folder or a binder as in typical PECS. In addition, during initial training phases, pictures were adapted to 8 x 8 cm in size as compared to pictures used in typical PECS, which are usually 5 x 5 cm in size. The communication board was positioned vertically and attached to the participant’s wheelchair to improve visualization. Adapting the size and framework of the pictures let the student participant handle them more easily especially in the beginning of PECS training. As the participant made progress on PECS, the pictures were reduced to 4 x 4 cm that almost used in typical PECS.

Almeida et al. (2005) also modified some procedures of PECS. For example, in PECS Phase 1 of the study, the participant just needed to point to pictures instead of picking them up as in typical PECS. This adaptation of procedure was needed to be appropriate with the child’s motor abilities. Using an AB design, Almeida et al. indicated that the participant mastered the adapted five PECS phases that were taught during the study. For example, the participant achieved 100% of independent responses in four consecutive sessions during Phase 1, while the performance in baseline was 0% of independent responses. The researchers concluded that adapted PECS was effective in teaching requesting skills for a child with quadriplegic athetoid cerebral palsy. The researchers recommended expanding the adapted PECS presented in the study for more students with cerebral palsy and other students with disabilities (Almeida et al.).

Malandraki and Okalidou (2007) investigated the use of all PECS phases, with some adaptations in materials and procedures, to teach communication skills for one participant with profound hearing loss and autism. Although the ten-year-old participant
was exposed to training on lip reading and sign language for three years, he did not use sign language to communicate functionally with people. Because the participant was non-verbal and because other communication programs were not successful in teaching the participant with deafness and autism a functional communication skills, PECS was chosen as an alternative communication system. Malandraki and Okalidou indicated that the goal of the study was to teach functional communication skills by using PECS, with some modifications in materials and procedures of PECS made to be appropriate with the participant’s hearing loss and writing abilities. Instead of using only pictures as in typical PECS, a gradual replacement of pictures by written words was used. For example, pictures were presented alone, then they were presented with written words, and completely they were replaced by written words.

In addition, Malandraki and Okalidou (2007) indicated some adaptations in procedures of PECS were made to meet the hearing loss of the participant. For example, all verbal praises involved in PECS were given using sign language, facial expressions, or shoulder patting. After a 4-month intensive program including training sessions held in a variety of the participant’s daily living environments, the student achieved the criterion in each phase of the six phases of PECS, which was 80% success in independent responses for one training session. At the end of the study, the participant learned to use the PECS communication book spontaneously in actual living environments (Malandraki and Okalidou, 2007). Malandraki and Okalidou concluded that this study demonstrates the effectiveness of PECS with adaptations in materials and procedures to be appropriate with the participant’s hearing loss and writing ability.
Finkel, Weber, and Derby (2004) investigated the effectiveness of a Braille Exchange Communication System (BECS) on an adult participant with moderate mental retardation and blindness to teach word articulation, vocal mands, and requesting skills. Finkel et al. made certain adaptations to standard PECS materials and procedures to be easily used by a participant with legally blind and moderate mental retardation. For example, because the participant was able to read first level Braille, the participant used cards including words written by Braille for exchanging with preferred items instead of pictures as in typical PECS.

By using a multiple baseline design across four sets of words written by Braille, Finkel et al. (2004) indicated that the participant showed a significant increase in the number of independent communication exchange through the four sets of words. For example, in the first set of words, the mean number of independent communication exchanges during Baseline was 0 out of 20 trials, while the mean number of independent exchanges was increased during the intervention to 15 out of 20 trials.

Finkel et al. (2004) used different procedures than those used in PECS. For example, instead of enticing a student with a preferred item as in typical PECS, the participant was asked, “What do you want?” as a discriminative stimulus. Although Finkel et al. mentioned that the physical prompting was faded using a backward chaining, no clear indication was provided if the discriminative stimulus, “What do you want?”, was also faded. Therefore, the participant might depend on the verbal cues, “What do you want?”, during the study instead of enticing with a preferred item without using any verbal prompt as in typical PECS.
Lund and Troha (2008) made certain adaptations to standard PECS to be easily used by three students who had cognitive disabilities, autism and blindness. These students were at pre-Braille level. Instead of using pictures as in standard PECS, Lund and Troha used tactile, or tangible, symbols with three dimensions to be easily used by the participants who are blind. In addition, while in standard PECS, trainers do not use verbal cues in their communications with children, Lund and Troha mentioned that trainers used verbal cues to the participants to indicate the trainer’s location and presence. When the trainer began any session training in the study, the trainer said to the participant “Hi…, it’s choice time” to indicate the trainer’s presence for the participant who was blind (Lund & Troha). Therefore, the participants might depend on the verbal cue “Hi…, it’s choice time” during the study instead of choosing the appropriate method of enticement with a preferred item without using any verbal prompts as in typical PECS.

Lund and Troha (2008) indicated that one of the three study participants completed the communication program successfully. Although the other two participants did not reach the criteria or complete the program, they exhibited improvement in performances between baseline and the intervention phases. Lund and Troha mentioned an important limitation in the study was that each participant had only one tangible symbol for one preferred item during all sessions in the study. For example, one participant had only a Rain Stick as a preferred item during all sessions. However, in standard PECS (Frost & Bondy, 2002), using more than one reinforcer during a training session is preferred as a student might not be interested in the same reinforcer all the time. In standard PECS, a trainer needs to assess if the reinforcer is still reinforcing
before doing any training. Usually the trainer uses a “First One’s Free” strategy in which the trainer offers a piece of the item, or lets the student play with the item for few seconds. If the student consumes or plays with the item, then the item is assumed to still be reinforcing. However, in Lund and Troha’s study, each participant had only one preferred item and no indication that the “First One’s Free” strategy was implemented.

In addition, Lund and Troha, 2008 used hand-over-hand support for all trials in the first two training sessions, and then they used a modified least-to-most prompting hierarchy in remaining sessions. Lund and Troha believed two of the three participants to be dependent on physical prompts since they did not make significant progress with independent responses. Another limitation in Lund and Troha’s study was the lack of implementation of a gradual fading strategy. Frost and Bondy (2002) recommended using a gradual fading strategy based on a backward chaining in which the trainer fades the last skill then the last two skills and then fading the all skills. Using a backward chaining in PECS training as a gradual fading strategy let a student demonstrate independent responses (Frost & Bondy).

Tangible symbols are symbols with two or three dimensions (Rowland & Schweigert, 1989) that could be either whole objects, small samples of objects, or partial objects fixed on cards (Trief, 2007). Using tangible symbols has been effective in teaching communication skills for individuals with multiple disabilities including visual impairment (Rowland & Schweigert; Trief). Because the tangible symbols are representational and related to their referents, they are more meaningful to individuals with visual impairment and cognitive disabilities (Rowland & Schweigert). Tangible
symbols could be manipulated such that an individual can communicate with others by touching, pointing or picking up these symbols to express her or his needs (Rowland & Schweigert).

According to Trief (2007), twenty-five participants with multiple disabilities including cognitive disabilities and visual impairment were taught to use the tangible symbols to communicate. The participants were asked to explore and hand over the correct tangible symbol that signified an activity before starting an activity. Trief concluded that 15 out of 25 participants learned to choose the correct tangible cues that were related to the activities.

A three-year study was conducted using tangible symbols to teach communication skills for 41 children with multiple disabilities (Rowland & Schweigert, 2000). Rowland and Schweigert concluded that the majority of participants, 35 out of 41 participants, learned to use tangible symbols, choosing the symbols that corresponded with their preferred objects from the other symbols presented.

The importance of using PECS to teach communication skills through tangible symbols rather than using other strategies is based on several advantages. The first advantage is that the strategies that are used to teach tangible symbols other than PECS are based on responding to verbal requests (Ganz et al., 2005). For example, Trief (2007) concluded that participants were asked to choose between two tangible cues before beginning the activities, while in PECS, a learner initiates for communication as she or he requests her or his preferred items or activities. Secondly, by using PECS, the learners are more motivated than in other teaching strategies because they communicate to request
their preferred items and activities (Ganz et al.). Thirdly, when using strategies other than PECS, the learners need to imitate responses as pre-requisite skills such as sign language. However, in PECS, the learners do not need to imitate responses, and are more likely to learn spontaneous requesting skills that meet with the definition of functional communication skills (Bondy, 2001).

Conclusion

Based on the studies analyzed about the effectiveness of PECS on teaching requesting skills to students with disabilities, only one study so far was found about teaching PECS to students with visual impairment and multiple disabilities at pre-Braille level (Lund & Troha, 2008). In addition, three important limitations were found in Lund and Troha’s study that included the following: using one tangible symbol only for one preferred item to each participant during all training sessions, using verbal cue “Hi…, it’s choice time” instead of enticing participants with preferred items, and not using effective gradual fading procedures based on the results of the participants’ independent responses in the study.

Lund and Troha (2008) provided preliminary results supporting the use of tangible symbols with adapted strategies from PECS to teach requesting skills to students who have multiple disabilities including visual impairment. They recommended further research should be conducted on the use of PECS to teach requesting skills to students with multiple disabilities and visual impairment. Therefore, the purpose of this study is to expand the use of PECS to students with visual impairment and multiple disabilities and
to overcome important limitations in Lund and Troha’s study. In this study, the investigator examined the effectiveness of combining tangible symbols and adapted strategies from PECS to teach requesting skills to pre-Braille level students with multiple disabilities and visual impairment.
CHAPTER 3
METHOD

Setting

This study was conducted in a K-12 school that provided comprehensive educational services to children with visual impairment and multiple disabilities in southern Arizona. Academic instruction was typically delivered Monday through Thursday from 8:00 a.m. to 3:00 p.m., and on Friday from 8:00 a.m. to 1:00 p.m.

In addition to teaching academic skills, the school provided other educational services such as a daily life-skills program, Community Based Instruction (CBI), and a transition program to students with multiple disabilities whose educational needs were not easily met in traditional academic settings.

The particular institution was chosen because historically the school had been very acceptable to projects and research. Also, the school provided services to a wide range of students with visual impairment and multiple disabilities who had specific needs in the area of communication.

Participants

The study participants were four school-aged students, three girls and one boy, who were instructed in self-contained classes for students with visual impairment and multiple disabilities. The students' ages ranged from 7 to 14 years. Additionally, the participants met the following criteria:
1. Little or no verbal communication skills;

2. No prior training of PECS;

3. Other identified difficulties in overall communication skills, based on information provided by the teachers and parents and school records;

4. Intellectual disabilities ranging from mild to severe cognitive impairments, defined as “…significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social, and practical adaptive skills. This disability originates before the age of 18” (Luckasson et al., 2002, p. 8);

5. Visual impairment based on the evaluations of board-certified ophthalmologist defined as an “…optically or medically diagnosable condition of the eye(s), visual system, or brain that affects the structure or functioning of the tissues and results in less than normal vision” (Barraga & Erin, 2001, p. 23);

6. Experience with tangible symbols or pictures paired with tangible symbols as other visual materials to aid them in the recognition of objects; and

7. Parental consent.

Stephanie

The first participant, Stephanie, was an 8 year-old girl attending a self-contained classroom for students with visual impairment and multiple disabilities. Per Stephanie’s 2008-09 Individual Education Plan (IEP), she was diagnosed with moderate mental
retardation, autism, and legal blindness. For desk work, Stephanie used some adaptive aids: a desk lamp and a slant board. According to her IEP, Stephanie was able to fixate on an object at 6 inches for 10 seconds, and shift her gaze from 1-inch object to another at a distance of 3 inches. In addition, the IEP stated that Stephanie presented a left eye preference and typically viewed objects at an eyeball distance, but could also see objects at a distance of 3-6 inches.

Stephanie’s intentional communicative acts were characterized by using one to three word utterances as well as using gestural communication such as pulling an adult’s hand or reaching out her own hand. Stephanie sometimes needed prompting from adults to say what she wanted. As reported by her teachers, Stephanie has expressed high levels of frustration when unable to communicate a need, evidenced by pinching, grabbing, or biting others in close proximity. Also, Stephanie often described what she was doing or thinking to herself, rather than engaging in communication with others around her. In the past, she had used voice output devices with limited success because she tended to perseverate on recorded sounds and voices. With regard to her motor skills, Stephanie was developing hand strength, spatial relationships, and sustained contact with materials to engage buttons and snaps, and use utensils. Stephanie was able to walk alongside her instructor for entire cross-campus routes using the sighted-guide technique.

Stephanie’s primary sensory learning channel was visual, with some tactile assistance. Typically, she did not use auditory means to assist her in accessing objects and information in her environment. She used real objects and/or pictures paired with tactile symbols to obtain information. She was not yet a Braille user, but was involved in
a functional literacy program at school, and received a significant amount of exposure to Braille and tactile symbols.

One of Stephanie’s 2008-09 IEP goals was to use tactile symbols, sign language, as well as verbal language to communicate with others. Because of this, the PI along with the school instructors thought Stephanie could benefit in learning PECS to attach meaning to the use of tactile symbols paired with pictures. Stephanie had not been received any training on PECS program prior to the study.

Sameera

The second participant, Sameera, a 7 year-old girl, attended a self-contained classroom for students with multiple disabilities including visual impairment. Based on Sameera’s 2008-09 IEP, Sameera was diagnosed with moderate mental retardation, cerebral palsy, and a visual impairment (bilateral optic atrophy, bilateral estropia and extropia).

Sameera utilized highly contrasted, colorful materials for her school work. She could label familiar objects and people from a viewing distance of approximately one to two feet. Sameera was non verbal and a pre-Braille student who used whole objects to gain information about her environment. When making choices during her daily routine, Sameera could visually make a clear choice between two real objects held out in front of her and was able to reach for the preferred item. One of Sameera’s 2008-09 IEP goals was to learn that objects could carry meaning and be used to communicate with others.
Per the teacher’s report, Sameera was very friendly, enjoyed interacting with her peers through eye gaze or touch, and preferred to be close in proximity to others. She used a wheelchair and reached for objects that would come into her view. Though non-verbal, Sameera had some vocalizations when attempting to communicate with others. In order to use tangible symbols effectively, Sameera used a slant board and whole or partial objects. Sameera had not received any training on PECS prior to the study.

John

The third participant, John, a 14 year-old boy, attended a self-contained class for students with multiple disabilities including visual impairment. Based on information from John’s 2008-09 IEP, John was diagnosed with moderate mental retardation, autism, a visual impairment (optic nerve-hypoplasia and nystagmus in both eyes), and an orthopedic impairment. John’s primary learning channel was tactile with a strong auditory channel. John needed hand-under-hand support to scan each tactile symbol.

When John was given only one choice, he would activate his voice output device with a slight touch on his elbow provided by his teacher. For most opportunities, John needed a physical cue to activate his voice output device at the appropriate moment in the classroom routine, but occasionally he would use it independently. At times, John could respond verbally to a verbal request for a preferred item or activity. For example, when John was asked “Do you want to listen to the guitar?” John responded “Guitar”. He displayed spontaneous rejection of items or activities by biting his knuckles and tensing his body. Given several repeated verbal requests, John would sometimes say, “No thank
you”, but this was inconsistent. John had not received any training on PECS prior to the study.

Layan

The fourth participant, Layan, a 13 year-old girl, attended a self-contained classroom for students with multiple disabilities including visual impairment. Based on information from Layan’s 2008-09 IEP, Layan was diagnosed with moderate mental retardation, autism, and total blindness. Layan communicated using non-verbal behavior as well as approximations of one-word utterances such as “yes”, “no”, “okay”, or “potatoes”. For requesting skills, Layan depended typically on verbal prompts that presented choices. For example, Layan said “CD” when a teacher asked her “Do you want the tape or CD?”

During routine conversation, Layan used short sentences of two to three words when a verbal model was provided. Layan used subtle body movements and actions toward objects to indicate wants, needs, rejections, as well as to make requests. In a group activity with peers, Layan could engage in conversations when provided with multiple verbal prompts.

Layan began using a voice output device, the Go Talk 9+, in the 2008-09 school year to indicate snack choices within the classroom. Presented a set of choices with tactile symbols, with some physical prompting, Layan could activate the device successfully. For example, when a desired snack item was presented to her in her hand, and then her hand was prompted to touch the target symbol placed on the switch, she
would press the symbol to activate the device. Layan had not received any PECS training prior to the study.

Staff

The staff included the principal investigator (PI) who was the main PECS trainer, two other PECS trainers, and two secondary observers. The PI trained the other PECS trainers and the secondary observers in the implementation of the three phases of adapted PECS as specified in the study. Two trainers implemented PECS training during Phases 1 and 2, while only one trainer was required for PECS training in Phase 3. One trainer was the communicative partner, and the other trainer was the physical prompter. The communicative partner would sit in front of a participant, take the tangible symbol from the student, and hand a preferred item back to the student. The physical prompter would sit behind or next to the participant to provide physical prompting.

Staff Training on PECS

The PI attended a two-day basic training workshop provided by the one of the consultants from the Pyramid Corporation, the source of PECS. In addition, the PI, who had been a teacher for three years of children with severe and multiple disabilities, carefully reviewed the PECS training manual (Frost & Bondy, 2002).

The PI trained the other PECS trainers as well as the two secondary observers with the adapted PECS procedures via two 2-hour training sessions. These training sessions included the following procedures:
1. A Power-Point (PPT) presentation about the three phases of the adapted PECS process, with hard copies of the PPT for each trainer;  
2. Hands-on, supervised training with feedback for each trainer; and  
3. Practice sessions for each trainer regarding the PECS procedures of the study until the trainer was able to perform each PECS phase without depending on written instructions.

During the data collection period, the PI periodically reviewed the procedures for each PECS phase with both trainers and the secondary observer to confirm teaching and understanding of PECS. After conducting training sessions with the study participants, the PI, PECS trainers, and secondary observers shared feedback about the training sessions with the participants.

Training Setting

The training setting was a separate room outside each participant’s primary classroom. The generalization sessions were conducted inside each participant’s classroom.

PECS Training

The sequence of training steps in PECS is based on Skinner’s analysis of verbal behavior (Bondy, 2001). Based on Skinner’s perspective, the verbal behavior of the speaker is under the stimulus control of the listener and the listener in turn provides tangible or social rewards to the speaker (Bondy). To achieve spontaneous functional...
communication, a speaker initiates communication in order to get tangible or social reinforcement provided by a listener (Bondy & Frost, 2001). Therefore, the first goal of PECS is to teach requesting skills that meet the definition of spontaneous functional communication (Bondy). With PECS, a student learns to initiate communication by being enticed with an individual preferred item, and eventually responding without using a verbal or physical prompting (Bondy). In order to meet the definition of Skinner’s verbal behavior, the PECS protocol is based on teaching the student, or Speaker, to hand the picture or the symbol of a preferred item to someone who is offering that item, the Listener.

The rationale of PECS is based on the concerns of other communication programs such as speech training and sign language (Bondy & Frost, 2001). A student must develop imitation skills such as looking at the therapist and sitting appropriately in order to imitate the speech of the therapist, critical aspects of speech training (Bondy & Frost). The student who learns to imitate the speech of the therapist may fail to use speech in spontaneous communication because that child may then depend on the verbal prompting of others (Bondy & Frost).

Based on the limitations of speech training, service providers developed alternative and augmentative communication (AAC) systems such as sign language (Bondy & Frost, 2001). However, there are a limited number of communicative partners available to the user. In addition, in order to learn sign language, a child must imitate the gestures exhibited by the person using sign language (Bondy, 2001).
Speech and sign language training require imitation skills. Typically, in speech training and sign language, children, and especially children with autism, do not learn to initiate communication with others; rather, they respond to other communicative partners such as teachers or parents. Therefore, PECS was developed in 1985 by Bondy and Frost to teach spontaneous functional communication skills and especially to young children with autism (Frost & Bondy, 2002).

PECS, which includes six phases, holds both behavioral and developmental perspectives. PECS training incorporates teaching a child how to communicate, then teaching a child to communicate with specific messages using single pictures, and then to learn to communicate with multi-picture sentences (Frost & Bondy, 2002). PECS training is based on applied behavior analysis and includes fading procedures for physical prompting, error correction strategies, and reinforcement strategies.

Tangible Symbols

In this study, tangible symbols were created for each participant by the research team including the PI and each student’s teacher. The tangible symbols were 3-dimensional, either whole objects, small parts of objects, or samples of objects mounted on boards (Trief, 2007). The sizes of the symbols were determined by participant’s recognition skills. Velcro were glued on the back of each symbol to attach to the each participant’s individualized binder, or communication book. Velcro strips were also mounted on the outer cover as well as on each page of the communication book. Each participant had his individualized preferred items (e.g., food, toys, and/or activities)
that were exchanged with tangible symbols (See Table 2, Tangible Symbols; See Appendix D, photos of the participants’ tangible symbols).
Table 2
Tangible Symbols

<table>
<thead>
<tr>
<th>Participant</th>
<th>Item/Activity</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stephanie</td>
<td>1. Grapes</td>
<td>Piece of a grape stem paired with picture of grapes and the word “grapes” in bold mounted on 2” X 2” white foam board.</td>
</tr>
<tr>
<td></td>
<td>2. Pickles</td>
<td>Piece of bumpy cardboard paired with a picture of a jar of pickles and the word “pickles” in bold mounted on 2” X 2” white foam board.</td>
</tr>
<tr>
<td></td>
<td>3. Pizza</td>
<td>Red circular piece of foam paired with a picture of a pizza and the word “pizza” in bold mounted on 2” X 2” white foam board.</td>
</tr>
<tr>
<td></td>
<td>4. Paper clip</td>
<td>Single large paper clip glued diagonally across 2” X 2” white foam board.</td>
</tr>
<tr>
<td></td>
<td>(Distracter)</td>
<td></td>
</tr>
<tr>
<td>Sameera</td>
<td>1. M &amp; Ms</td>
<td>Package of M &amp; Ms cut in half mounted on 3” X 3” white foam board (partial object).</td>
</tr>
<tr>
<td></td>
<td>2. Banana</td>
<td>6” plastic toy banana with Velcro attached.</td>
</tr>
<tr>
<td></td>
<td>3. Recorded music</td>
<td>Mini cassette tape mounted on 3” X 3” white foam board, raised to facilitate grabbing (partial object).</td>
</tr>
<tr>
<td></td>
<td>with switch</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Mandarin oranges</td>
<td>The bottom half of a small plastic mandarin orange container mounted on 3” X 3 white foam board covered with bright orange paper for contrast (partial object).</td>
</tr>
<tr>
<td></td>
<td>6. Blank symbol</td>
<td>Shiny pink pipe cleaners glued to 3” X 3” white foam board.</td>
</tr>
<tr>
<td></td>
<td>(Distracter)</td>
<td></td>
</tr>
</tbody>
</table>
Table 2 (continued)

<table>
<thead>
<tr>
<th>Participant</th>
<th>Item/Activity</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>John</td>
<td>1. Juice</td>
<td>Blue plastic sippy-cup top mounted on 3” X 3” white foam board (Partial object).</td>
</tr>
<tr>
<td></td>
<td>2. Guitar</td>
<td>Two guitar strings with red highlighted border mounted on 4” X 2” white foam board (Partial object).</td>
</tr>
<tr>
<td></td>
<td>3. Wooden spoon</td>
<td>Part of the wooden spoon handle (3”) mounted on 4” X 2” white foam board (Partial object).</td>
</tr>
<tr>
<td></td>
<td>4. Piano</td>
<td>One black keyboard piano key mounted on 3” X 2” white foam board (Partial object).</td>
</tr>
<tr>
<td></td>
<td>5. Paper clips (distracter)</td>
<td>Three large paperclips mounted on 3” X 2” black foam board (Whole object).</td>
</tr>
<tr>
<td>4. Layan</td>
<td>1. Apple sauce</td>
<td>Small plastic apple sauce container mounted on 3” X 3” white foam board (Whole object).</td>
</tr>
<tr>
<td></td>
<td>2. Mashed potato</td>
<td>Duct taped squishy squire mounted on 2” X 2” white foam board (Partial object)</td>
</tr>
<tr>
<td></td>
<td>3. Hash</td>
<td>Sixteen raised glue-gun dots mounted on 2” X 2” white foam board.</td>
</tr>
<tr>
<td></td>
<td>4. Water</td>
<td>Plastic looped “crazy straw” with 3 inch long mounted on 3” X 3” white foam board (Partial object)</td>
</tr>
<tr>
<td></td>
<td>5. Spaghetti</td>
<td>Five raised glue-gun lines with 2 and half inch mounted on 2” X 2”white foam board.</td>
</tr>
<tr>
<td></td>
<td>6. Styrofoam (Distracter)</td>
<td>3” Styrofoam (cylinder shape) with rough texture mounted on 3” X 3”white foam board (Whole object).</td>
</tr>
</tbody>
</table>
Behavioral Definitions

Two dependent variables were measured in the study. The first dependent variable, the percentage of correct responses, was measured during the baseline sessions and during the training sessions in each of the three training phases as well as the maintenance phase. Each baseline and training had 10 trials. The correct response was scored when the participant independently picked up the tangible symbol or chose the correct symbol between two tangible symbols, reached to the communicative partner, and released the symbol into the partner’s hand. The percentage of correct responses was measured by dividing the number of correct responses by 10 trials, and then multiplying by 100%. To move from one phase to next in this study, each participant was required to attain at least 80% correct responses for two consecutive sessions. Daily training sessions were conducted for each participant when possible. The number of required training sessions for each phase varied depending on the student’s performance on the training sessions.

The second dependent variable, a response of “yes” or “no”, was measured during the generalization sessions of each PECS phase, and during the generalization sessions of maintenance phase. Each generalization session was just one trial conducted in each participant’s classroom. “Yes” was recorded, if the participant picked the symbol up independently, or picked the correct symbol between two tangible symbols; reached to the communicative partner; and released the symbol into the partner’s hand and without any physical or verbal prompting. “No” was recorded if the participant did not pick the symbol up independently, or did not pick the correct symbol between two tangible
symbols; reach to the communicative partner; and release it into the partner’s hand. At least one generalization session was conducted at the end of each phase of the three PECS phases and during maintenance phase.

Research Design

A *multiple probe* design across subjects, a variation of a *multiple baseline* design, was used in the study (Richards, Taylor, Ramasamy, & Richards, 1999). In a multiple probe design, the researcher does not collect continuous recordings of all baseline measures before introducing the intervention. The continuous baseline measurement may cause strong participant reactions (e.g., such as screaming or biting an available object when unable to have the preferred item). Instead, the researcher makes periodic recordings of baseline levels to ensure no significant changes have occurred before introducing the intervention (Richards et al., 1999). Also, there is a strong *a priori* assumption of stability (i.e., the correct response is not likely to occur because the participants have not been trained on intervention prior to the study and the intervention will be in a separate setting). Therefore, taking periodic recordings of baseline is considered a beneficial alternative to continuous baseline measurement (Horner & Baer, 1978).

Data for each participant were collected during the following three conditions: (a) baseline, (b) the PECS training phases, and (c) the maintenance condition. During the baseline and generalization conditions, the dependent variable was measured without providing any PECS training. During the PECS training phases, the sessions were
structured to teach the participants to the three PECS phases. At the end of each PECS training phase, i.e., when the participant had achieved a minimum of 80% correct responses for two consecutive sessions, at least one generalization session was conducted.

Procedure

The study was conducted in four parts: (a) the assessment of reinforcers, (b) baseline, (c) the implementation of the intervention, which was teaching the three PECS phases and conducting generalization sessions, and (d) the maintenance condition. The next section includes the specific procedures of each part of the study.

Part 1: Assessment of Reinforcers

In order to teach the participants to make requests, the PI needed to determine the preferred (i.e., reinforcers) and non-preferred items for each study participant (see the reinforcers of participants table). This assessment process for each participant was a maximum 2 ½ hour long session during regular school hours in one week. To assess appropriate reinforcers for each study participant, the PI conducted staff interviews and assessments of Reinforcer Hierarchy (Frost & Bondy, 2002). Interviews were conducted using the Vocabulary Selection Worksheet (see Appendix A-1) with teachers or service providers who knew the students’ preferred and non-preferred items or activities. Assessments of reinforcer hierarchy were conducted to determine the most highly
preferred items, or reinforcers. Assessments of reinforcer hierarchy identified for each participant involved the following steps (Frost & Bondy, 2002):

1. The PI offered one of the items that the participant liked based on information in the interviews. The PI observed the following behaviors: reaching for the item, taking the item, or rejecting it.

2. If a participant took the item, the PI immediately tried to take this item back and observed the participant’s reaction. For example, a participant may have tried to get the item back or the participant may have allowed the PI to keep the item. The PI would give this item to the participant once more, observing if the participant took the item again or rejected it again.

3. The PI observed the participant’s behavior when the participant took any item or reinforcer. For example, the PI observed if the participant consumed the reinforcer, played with it, made sounds to indicate pleasure, or perhaps just holding the item without consuming or playing with it.

4. The PI listed the items that the participant reached for, took, resisted when taken away, consumed or played with, took again when presented a second time, or rejected. By this point, the PI knew of at least three preferred items, sometimes four. The schedule of the Reaction to one-preferred item was used (Frost & Bondy, 2002; see Appendix A-2)

5. The PI presented two of three (or four) preferred items to the participant. The participant then chose one of these two preferred items and the PI observed what item the participant took first each time. The PI could repeat this step
three to four times to observe which item the participant selected most often between the preferred items, which then became the most preferred item. The PI presented preferred food items with other preferred food items, and preferred non-food objects with other preferred non-food objects.

6. The PI removed the two most preferred items from the first array and added a new preferred item to the least preferred one. The PI could repeat this step three to five times. See the schedule of the Most Often Preferred Item (Frost & Bondy, 2002; see Appendix A-3).

7. The PI presented the most preferred items (two at a time) asking the participant to make a choice. The trainer repeated this step three to five times or until the PI could rank the most preferred items by first, second, third, and fourth. See the schedule of the Ranking the Most Preferred Item (Frost & Bondy, 2002; see Appendix A-4).

The results of reinforcer assessments were based on interviews with people who knew the participants well, (e.g., classroom teachers and parents). The reinforcer assessments are presented in Table 3, including the reinforcer hierarchy for each participant. Table 3 also shows preferred food and/or drink items, preferred non-edible items, preferred activities, and non-preferred or irrelevant items or symbols.
<table>
<thead>
<tr>
<th>Participant</th>
<th>Preferred edible items</th>
<th>Preferred non-edible items or activities</th>
<th>Non-preferred items or symbols</th>
</tr>
</thead>
</table>

Part 2: Baseline Condition

During the baseline condition, only one trainer worked with the study participant. Because each participant had a visual impairment, the trainer presented the participant with one of the following options:
1. While the trainer placed the tangible symbol on the table, the trainer held one preferred item and moved it very closely to a participant so he/she could see the item and try to reach for it.

2. The trainer allowed the participant to smell and touch the preferred item, or the trainer guided the participant’s hand to touch the item before moving it the item slightly away from the participant’s hand.

3. The trainer may have presented the preferred item accompanied with noises such as rattling wrappers, chewing sounds, or any other sound to indicate the existence of the item (Frost & Bondy, 2002).

Choosing the method of enticement depended on each participant’s skills and recognitions.

To indicate the existence of a tangible symbol placed on a table, the trainer put the tangible symbols on a black or slant board for participants who had usable vision and could see the symbol. For participants who were unable to see the symbol on a table or a frame due to their visual loss, the trainer then moved a tangible symbol to provide an auditory cue that the tangible symbol was placed on a table while holding a preferred item in the hand. Once the participant picked up the tangible symbol, the trainer opened one hand to indicate where the student should put the symbol.

The correct response “1” was measured if the first response of the participant was picking up a tangible symbol from a table or on frame, reaching to the trainer’s open hand, and releasing the symbol into the trainer’s open hand independently. For each correct response, the trainer gave immediately the preferred item represented by the
tangible symbol and verbally praised the participant. The incorrect response “0” was measured if the first response of the participant was reaching to the preferred item not to the tangible symbol. In each baseline trial, the trainer observed the first response of the participant within 20 seconds for the three participants “Stephanie”, “John”, and “Layan”, and 40 seconds for the participant “Sameera” based on the difficulties of her motor skills as she needed more time than other participants to reach either to the item or to the tangible symbol before finishing the trial. The baseline condition, comprising 10 trials, did not permit any physical prompting (i.e., hand-over or hand-under-hand) or verbal direction to guide the participant to pick up the symbol, reach toward the trainer, or to release the symbol into the trainer’s open hand. Each trial was almost 20 seconds or more depending on the participant’s motor abilities. To insure that the item used was still reinforcing, the trainer gave a participant a free sample of any reinforcer used for the first time in the session. With this method, *First One’s Free*, the trainer offered a bit of food, or allowed the participant to hold or play with the item. If the participant consumed or played with the item for few seconds, then the item was assumed to be still reinforcing. If the participant did not reach to the item or the tangible symbol within 20-40 seconds during the trial, the item was considered not highly motivated currently even after a free sample and the trainer switched to another preferred item with a corresponding symbol. The trainer used a free sample for any reinforcer used in the first time in the session to figure if this item was reinforcing at current time.

Some participants protested, cried, or screamed when the preferred item was not present during a baseline trial. To decrease frustration, the trainer provided a participant
with a free sample of any preferred item between the baseline trails but not during the baseline trials itself.

Part 3: PECS Training Phases

During Part 3, the PECS training phases, the PECS trainers taught the three phases of communication system. At the end of each PECS training phase, at least one generalization session was conducted (Part 4 of the procedure, discussed later in this chapter). Following are the three phases of PECS that were implemented in this study.

Phase 1. The goal of the first phase, Phase 1, was teaching a participant to pick up the tangible symbol, reach toward the communicative partner, and release the tangible symbol into the communicative partner’s hand. Two trainers were needed for Phase I; the first trainer who sits or stands in front of the participant was the communicative partner. The second trainer who sits or stands beside or behind a participant to provide physical prompting was the physical prompter (Frost & Bondy, 2002).

With typical PECS trainings, one picture is placed on the table in front of the student each trial. The communicative partner holds a highly preferred item out of the student’s reach. The communicative partner begins the training trial by showing the highly preferred item to the student (Frost & Bondy, 2002)

The participants in this study were individuals with visual impairment and therefore they have visual difficulties seeing preferred items without certain adaptations. Therefore, other enticing methods were used. First, the tangible symbol was placed on a
table, slant board, or frame on a table for participants who had usable vision so they could more easily see the tangible symbol. Second, the trainer enticed the participants with visual impairment and cognitive disabilities using different methods. Choosing the method of enticement depended on each participant’s skills and recognitions. While the trainer placed the tangible symbol on the table, slant board, or frame, the trainer held one preferred item and moved it very close to a participant so he/she could see the item and try to reach for it. At times, the trainer let the participants smell and touch the preferred item, or even put the participant’s hand on the item and then moving it away slightly (Frost & Bondy, 2002). The trainer also may have presented the preferred item accompanied by a noise, such as wrappers rattling, chewing sounds, or any other sound indicating to the participant that the trainer held a preferred item (Frost & Bondy). The trainer may have used a “First One’s Free” strategy by offering a piece of consumable preferred item, or may have let the participant play with a non-consumable reinforcer for few seconds. If the participant ate or played with the item, then the trainer determined that the item was still reinforcing.

While the trainer enticed the student with one hand, the trainer could move the tangible symbol on the table to indicate the existence of a tangible symbol for the participants who were blind or had limited vision. The physical prompter, sitting behind or next to a participant, then provided a physical prompt only when the participant reached for the preferred item. The physical prompter used the hand-over-hand technique with a participant to pick up the tangible symbol, reach to the communicative partner, and release the symbol into the communicative partner’s hand. When a participant who was
physically prompted felt the communicative partner’s hand contact the symbol, the participant typically released the symbol into the partner’s open hand. When the participant reached to the tangible symbol or the preferred item, the communicative partner opened his/her hand to guide the student to put the symbol into the partner’s open hand.

Once the communicative partner took the symbol from the participant, he/she praised the participant immediately. For example, when a communicative partner took the symbol of cookies from the participant, the communicative partner said, “Cookies. Good, you want cookies” and then gave the participant cookies within a half second (Frost & Bondy, 2002). If the item was consumable, the trainer provided a small portion of food, the “First One’s Free” strategy (Frost & Bondy, 2002). While a participant was eating, drinking, or playing with a preferred item between trials, the two trainers got ready for the next trial. The communicative partner put the tangible symbol on a table, or slant board, or frame in front of the participant. The communicative partner then prepared another bit of food or drink or calmly took the non-consumable item from the participant. The trainer repeated the previous steps several times during the session. In this study, sessions ranged from 10-20 trials. A student participant could move from Phase 1 to Phase 2 when he/she reached at least 80% of correct responses for two consecutive sessions.

The physical prompter faded the prompts systematically by using a backward chaining technique (Frost & Bondy, 2002). With this technique, the physical prompter began fading physical prompts in the last step of the behavioral chain, the last two steps,
and finally in the all three steps of the chain. More specifically, the physical prompter faded the last step of assisting the participant to release the item into the trainer’s hand, then faded assistance with reaching toward the communicative partner, and lastly faded assistance with picking up the symbol (Frost & Bondy). The goal was to teach the participant to independently pick up the symbol, reach toward the communicative partner and release the symbol into the communicative partner’s hand over successive trials and sessions.

Occasionally, if the student participant did not perform a particular trial as expected, the physical prompter used a “Backstep Strategy” for error correction (Frost & Bondy, 2002). With this strategy, the physical prompter took the participant back to the last step completed correctly and provided physical assistance with the error step to complete the sequence. For example, if the student participant picked up the symbol but unexpectedly dropped it while reaching to the communicative partner, the prompter returned the symbol to the table in front of the participant, and the enticement process began again. Once the participant picked up the symbol, the prompter provided physical assistance for the participant to reach the partner. When the participant reached to a partner and gave the symbol, the partner praised the participant and gave the item within half a second. Furthermore, if the student played with a tangible symbol during the training session instead of reaching to the communicative partner, the physical prompter would interrupt this interfering behavior immediately. The physical prompter would provide a physical prompt to the student to reach and release the symbol into the communicative partner’s hand. If the physical prompter was unable to prevent the
interfering behavior immediately, the Backstep strategy was used for error correction (Frost & Bondy).

The preferred item was the most important factor for achieving success in Phase 1. Even after assessing the reinforcers, sometimes the participant did not like a specific reinforcer or the participant was no longer interested in that particular reinforcer especially after consuming pieces of it in during assessment trials. When the participant was no longer interested in a reinforcer, for example, he does not reach to preferred item or the tangible symbol, the communicative partner had two options: Switching the item and continuing other trials within the session, or ending the session. Frost and Bondy (2002) mentioned that a trainer could use the previously described “First One’s Free” strategy at the onset of the training to ensure that the item was still reinforcing. The training of Phase 1 continued for each participant until a participant achieved at least a percentage of 80% at performing independent responses for two consecutive sessions.

Phase 2. In Phase 2, the goal was for each participant to pick up the tangible symbol from the cover page of the communication book, reach to communicative partner’s hand, and release the symbol into the communicative partner’s hand. The main difference between Phases 1 and 2 was the increased distance between the communicative partner and the participant. While the distance between the communicative partner’s hand and the body of the participant was approximately 1 foot or less in Phase 1, the distance in Phase 2 was increased gradually to 2 feet or more. This was an important strategy used to teach the participant to keep communicating with others even when not close by. One
tangible symbol was attached with Velcro to the cover page of the communication book. As in Phase I, the participant and communicative partner were seated at a table facing each other, and the physical prompter sat beside or behind the participant.

The communicative partner began each trial with one of the previous mentioned methods of enticement. First, the communicative partner used the “First One’s Free” strategy by providing the participant with a small amount of the preferred food or a few seconds to play with the item. In each trial within a session, the communicative partner moved back slightly from the participant by inches until he/she was 2 feet or more away.

The tangible symbols were stored inside the communication book. During the training, one tangible symbol was attached to the cover page of the communication book and the other tangible symbols were inside the communication book (Frost & Bondy, 2002). The communicative partner would employ the “First One’s Free” strategy to quickly assess if the item was still reinforcing. After the participant consumed or played with the preferred item for approximately 10-15 seconds, the communicative partner put one tangible symbol on the cover page of the communication book and used one of the previously described methods of enticement.

The participant was required to remove the tangible symbol from the communication book, reach for the communicative partner, and release it into the communicative partner’s hand (Frost & Bondy, 2002). The physical prompter could provide physical assistance or guidance to remove the tangible symbol, but only after the participant reached for the tangible symbol and tried to remove the symbol from the
communication book. In subsequent trials, as prior noted, the communicative partner gradually increased the distance from the participant.

If a participant paused when reaching for the communicative partner, the physical prompter provided hand-over-hand guidance to the participant the moment he/she paused (Frost & Bondy, 2002). If the physical prompter did not provide hand-over-hand at the moment the student paused, the student may have waited for the physical prompter to guide him/her. If the physical prompter did not provide hand-over-hand or hand over arm at the moment the student paused, or if the participant dropped the symbol while reaching for the communicative partner’s hand, then the physical prompter used the *Backstep Strategy* for error correction (Frost & Bondy). The physical prompter put the tangible symbol back on the cover page of the communication book. The communicative partner began the method of enticement again, and the physical prompter provided hand-over-hand to guide the participant to reach for the communicative partner. Once the communicative partner received the tangible symbol from the participant, the communicative partner praised the participant and gave the preferred item to the participant within a half second (Frost & Bondy). The physical prompter faded the prompting until the participant independently picked up the symbol, reached for the communicative partner, and released the tangible symbol into the partner’s hand. As with Phase 1, the training in Phase 2 continued for each participant until she or he reached at least 80% in independent responses for two consecutive sessions.
Phase 3. In Phase 3, the goal is for the participant to choose the correct tangible symbol representing the preferred item from two tangible symbols i.e., learn discrimination skills. One tangible symbol represented the highly preferred item and another symbol represented the non-preferred item. As with Phase 2, the participant is trained to pick up the correct symbol from two symbols presented, reach to the communicative partner, and release the symbol into the communicative partner’s hand. Only one trainer, the communicative partner, participates in Phase 3. The physical prompter’s role is eliminated from Phase 3 (Frost & Bondy, 2002). Because the focus in Phase 3 is focusing on discriminating between two choices, the distance between the student and the trainer was the same as in Phase 1, 1 foot or less, and did not increase over these training sessions.

The participant and a communicative partner sat at a table, facing each other. The communicative partner placed two symbols on the cover page of the communication book and presented two items to the participant, using the method of enticement determined by the participant’s recognition skills as discussed in Phase 1. In Phase 3, the trainer presented the opportunity for the participant to see, touch, or smell both items. The communicative partner also presented the participant the opportunity to touch both tangible symbols. If the participant did not touch the symbols independently, the communicative partner guided the participant’s hand to the symbols. The participant then was required to select the symbol for the highly preferred item. Once a participant picked up the correct symbol, the communicative partner praised the participant immediately such as, “yes, uh-ha.” When the participant handed the correct symbol to the
communicative partner, the communicative partner gave her or him the highly preferred item and verbally praised the participant. If the participant picked up the symbol for the non-preferred item, the trainer provided no verbal response. When the participant gave the communicative partner the wrong symbol, the communicative partner presented the non-preferred or irrelevant item to the participant. At times participants reacted negatively to a non-preferred item by pushing it away or throwing it. In this case, a correction procedure was implemented as follows:

1. The trainer put the hand of participant on the correct symbol or tapped on the correct symbol in front of the participant.

2. The trainer physically prompted the participant to put the correct symbol into the communicative partner’s hand.

3. Once the participant gave the correct symbol, the communicative partner praised the participant without presenting the item.

4. The trainer distracted the participant for a short time (5 -10 seconds) by turning the communication book over and then returning it back. This distraction typically compelled the participant choose the correct symbol independently.

5. The communicative partner then presented both items with the two tangible symbols placed on the communication book. If the participant picked the correct symbol, the communication partner praised the participant directly. When the participant picked up the tangible symbol and handed the symbol to the communicative partner, the partner
immediately gave the preferred item to the participant accompanied with verbal praise. If the participant picked the non-preferred item, the correction procedure was implemented again (Frost & Bondy, 2002).

During the training sessions, the communicative partner tested the highly preferred items by using the “First One’s Free” strategy. At least, each participant learned to discriminate between one symbol for non-preferred or irrelevant item and two symbols for two preferred items.

To avoid memorization of the position of symbols on the communication book, the communicative partner rearranged the symbols after the participant performed any trial correctly. The communicative partner did not rearrange the symbols during the error correction procedure (Frost & Bondy, 2002).

If the participant continued to make errors even after three subsequent correction procedures, the trainer was able to finish the lesson successfully by returning to the mastery level training as in Phase I. The trainer would present one preferred item by placing one tangible symbol on the cover page of the communication book, and then the participant was required to exchange the symbol with the preferred item (Frost & Bondy, 2002).

Generalization Sessions. Each generalization session was one trial or opportunity conducted in each participant’s classroom. The dependent variable, a correct response, was scored as “yes” (100%) or “no” (0%). In a generalization session, one tangible symbol was presented to the participant during Phases 1 and 2, and two tangible symbols
were presented during Phase 3. In the generalization session, the physical prompter was not involved and only one trainer enticed a participant with a preferred item. “Yes” was recorded if the participant independently picked up the tangible symbol, reached toward the communicative partner, and released the symbol into the communicative partner’s hand. “No” was scored if the participant did not pick up the symbol, reach toward the communicative partner, and release it into the partner’s hand.

During generalization sessions, the trainer offered no physical or verbal prompting to guide a participant to make the correct response. In addition, no error correction procedures were provided. At least one generalization session was conducted at the end of each PECS training phase. The generalization sessions differed from training sessions in two ways: (a) Each generalization session was only one trial while a training session included 10 trials; and (b) the generalization sessions were conducted in a natural setting, the classroom, while the training sessions were conducted usually in separate room outside the classroom.

Part 4: Maintenance

Each participant moved to maintenance sessions when the participant met the criterion of Phase 3. During maintenance sessions, no training was provided. In each maintenance session, a trainer conducted 10 trials in a separate section or a separate room outside the classroom as the setting of the training session and one trial inside the classroom as the setting of the generalization session. An observer measured each participant’s responses with the same symbols used in Phase 3 but without any training
provided. The physical prompter was not existed in a maintenance session. In addition, no error correction procedure, or a physical or a verbal prompting was provided during a maintenance session. A primary and secondary observer measured ten responses outside the classroom and one response inside the classroom.

PECS Adaptations
The PECS training was based on the guidelines described in Frost and Bondy’s (2002) PECS training manual with some adaptations in materials and procedures described in Table 4.

Data Collection and Analysis
Direct Observation
In a training session, the dependent variable was the percentage of correct responses, measured by dividing the correct responses by the total responses for each session, and then multiplying by100. The correct response was scored if the participant independently performs the following behaviors: picks up the symbol or chooses the correct symbol from two symbols, reaches toward the communicative partner, and releases the symbol into the partner’s hand. The primary observer, the physical prompter, observed the trials by using trial-by-trial procedure (See appendices B-1, B-2, B-3, and B-4 as examples of observation sheets). The physical prompter observed the first ten trials in each baseline and training session, and each trial in the generalization session.
Table 4

PECS Adaptations

<table>
<thead>
<tr>
<th>PECS Modifications</th>
<th>Rationale of Modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instead of using pictures for exchanging with preferred items, the participants were presented tangible symbols or pictures paired with tangible symbols through all phases.</td>
<td>Because the participants could not see pictures or they had visual and cognitive challenges in recognizing 2-dimensional pictures, the participants used tangible symbols or pictures were paired with tangible symbols so they could be more easily seen.</td>
</tr>
<tr>
<td>Instead of presenting preferred items as is done typically in PECS trainings, an appropriate method of enticement was determined by the participants’ skill level.</td>
<td>The participants could not see the preferred items or they had visual difficulties seeing the items. At least one of the following methods of enticement were used by the trainer for each participant: (a) Allowing the participant to touch the preferred items, (b) moving the preferred items very close to the participants, (c) presenting the items accompanied by a noise, or (d) allowing the participant to smell the preferred items. Choosing the method of enticement was based on the participant’s skill level.</td>
</tr>
<tr>
<td>The trainer moved the tangible symbol that was placed on a table to provide an auditory cue for participants who had a visual impairment.</td>
<td>The students without visual impairment can see a preferred item and a corresponding picture (symbol) placed on a table at the same time. However, some participants could not see the tangible symbols placed on the table while enticing with the preferred items. Therefore, the trainers moved the tangible symbols on the table to provide an auditory cue about the existence of tangible symbols while enticing the preferred items and to be equivalent with students without visual impairment.</td>
</tr>
</tbody>
</table>
Table 4 (continued)

PECS Adaptations

<table>
<thead>
<tr>
<th>PECS Modifications</th>
<th>Rationale of Modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>With typical PECS trainings, the tangible symbols are</td>
<td>Because some participants who are students with visual impairment had to view the tangible</td>
</tr>
<tr>
<td>usually placed directly on a table. In this study, the</td>
<td>symbols very closely, slant boards were used for easier recognition of the tangible symbols.</td>
</tr>
<tr>
<td>tangible symbols were placed on or attached to slant</td>
<td>In addition to visual difficulties, slant boards were used for two participants who had</td>
</tr>
<tr>
<td>boards determined by each participants’ skill level</td>
<td>physical challenges with picking up the symbols from the table.</td>
</tr>
</tbody>
</table>

Inter-observer Agreement (IOA)

To assess inter-observer agreement (IOA), a secondary observer observed a minimum of 30% of the sessions including baseline, PECS Phases 1, 2, and 3, and maintenance. The two independent observers observed the number of correct responses that occurred in the session. IOA was calculated by using the trial-by-trial method with data compared by each observer for each trial. When both observers scored a “+” for the same trial, this was considered an agreement (Umbreit, Ferro, Liaupsin, & Lane, 2007). IOA was calculated by dividing the number of agreements by the total number of trials (10), and multiplying the result by 100% (Umbreit et al., 2007). The two observers coordinated to score the same number of trials.
Treatment Integrity

Treatment integrity was measured for 30% of all sessions, including baseline, PECS Phases 1, 2, and 3, and the maintenance conditions. Certain components were observed by the inter-observer during baseline, PECS training phases and generalization sessions (See Appendix C). Treatment integrity was measured by dividing the observed implemented components of the session by the total possible number of components. The criterion for acceptable treatment integrity was a minimum score of 80%. Treatment integrity was measured during the baseline and generalization sessions to insure that no physical or verbal prompting was provided by the trainer.
CHAPTER 4
RESULTS

Visual Analyses and Descriptive Statistics

The results of single-subject designs, including multiple probe designs across subjects, are best presented using visual analyses and descriptive statistics. Per Richards et al. (1999), “Visual analysis of data is used generally when continuous numerical data are gathered, data are graphically depictive and the researcher wants to make formative as well as summative analyses of study outcomes” (p. 267). The data for this study graphically present both the percentage of correct responses of PECS and the “Yes” and “No” scores of the generalization sessions (Figure 1).

Percentage of Correct Responses and “Yes” and “No” scores

Stephanie. As shown in Figure 1, Stephanie did not make any correct responses during baseline ($M = 0\%$). However, during intervention and during PECS Phase 1, Stephanie’s percentage of correct responses on PECS increased significantly ($M = 85\%$). Stephanie met the criterion of scoring at least 80% correct responses during two consecutive sessions and was therefore able to move on to Phase 2. During Phase 1, Stephanie had two generalization sessions (a single trial per session inside the classroom), both with “Yes” scores.
During Phase 2, a high percentage of correct responses continued ($M = 96.7\%$). Stephanie met the criterion to move to PECS Phase 3, again performing two consecutive sessions with at least 80% correct responses. Stephanie had one generalization session during Phase 2 with a “Yes” score.

During Phase 3, Stephanie’s percentage of correct responses increased significantly with results during baseline. Specifically, responses increased from an average of 0% correct responses during baseline conditions to an average of 76.7% correct responses during Phase 3. Stephanie met the criterion to proceed to maintenance conditions, performing two consecutive sessions with at least 80% correct responding. During maintenance, Stephanie performed 100% correct responses ($M = 100\%$) and performed all generalization sessions with “Yes”.

*Sameera.* As shown in Figure 1, Sameera had no correct responses during baseline ($M = 0\%$). The percentage of correct responses increased during PECS Phase 1 ($M = 63\%$). Because Sameera performed two consecutive sessions with at least 80% of correct responses, she was able to move on to PECS Phase 2. During Phase 1, Sameera performed one generalization session with a “Yes” score.

During Phase 2, Sameera performed three consecutive sessions with 100% correct responses ($M = 100\%$). She also performed one generalization session with a “Yes”. During Phase 3, a high percentage of correct responses continued ($M = 90\%$). Sameera also performed two generalization sessions, the first one was a “No” score, and the second one was a “Yes”.
During maintenance conditions, Sameera performed four consecutive sessions with 100% correct responding ($M = 100\%$). She also performed four generalization sessions with “Yes” scores.

*John.* As shown in Figure 1, John did not perform any correct responses during baseline ($M = 0\%$). During PECS Phase 1, John’s percentage of correct responses increased greatly ($M = 66\%$). John met the criterion to move to PECS Phase 2 as he performed two consecutive sessions with at least 80% of correct responses. John performed two generalization sessions during Phase 1 with “Yes” responses.

During Phase 2, a high percentage of correct responses continued ($M = 100\%$). John met the criterion of Phase 2 and moved to Phase 3. He also performed two generalization sessions during Phase 2 with “Yes” responses. During Phase 3, John’s percentage of correct responses on PECS increased significantly from percentage of correct responses during baseline conditions ($M = 91.7\%$). John also had two generalization sessions with “Yes” responses. During the Maintenance condition, a high percentage of correct responses continued ($M = 93.3\%$). John had five generalization sessions during maintenance with “Yes” responses.

*Layan.* As shown in figure 1, Layan did not perform any correct responses during baseline ($M = 0\%$). However, during PECS Phase 1, the percentage of correct responses increased significantly to average 80% correct responses. Layan also performed one generalization session during Phase 1 with “Yes” response. Because Layan performed
two consecutive sessions with at least 80% correct responses, she met the criterion to move to Phase 2.

During Phase 2, a high percentage of correct responses continued ($M = 82.5$). Layan also performed one generalization session with “Yes” response. During Phase 3, Layan’s percentage of correct responses increased significantly with results during baseline. Specifically, responses increased from average 0% correct responses during baseline conditions to average 90% correct responses during Phase 3. Layan also performed one generalization session with “Yes” score during Phase 3.

During maintenance condition, Layan performed two maintenance sessions with average 95% correct responses. She also performed two generalization sessions with “Yes” scores during maintenance conditions.

Treatment Integrity and Inter-observer Agreement (IOA)

*Stephanie.* During baseline, treatment integrity for Stephanie’s intervention in the 10-trial sessions was 0% with IOA at 100%, indicating that no physical, verbal, or error correction was provided during a baseline session. Treatment integrity of the 10-trial sessions was at average 100% with IOA at average 100% during PECS Phases 1 and 2. During PECS Phase 3, the treatment integrity was also at a high level, 95% and with IOA at 85%. During maintenance conditions, the treatment integrity decreased to 0%, with IOA averaging 100%. Treatment integrity during generalization sessions for Stephanie
Figure 1. Percentage of correct responses and “Yes” and “No” scores.
was constant at an average of 0% and IOA scores averaging 100% during all three PECS phases and during maintenance conditions. See Table 5.

Table 5

IOA and Treatment Integrity Scores for Stephanie

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOA</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>85%</td>
<td>100%</td>
</tr>
<tr>
<td>Treatment Integrity</td>
<td>0%</td>
<td>100%</td>
<td>100%</td>
<td>95%</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOA</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Treatment Integrity</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Sameera. During the baseline condition, treatment integrity of Sameera in the 10-trial sessions was 0% with IOA at an average of 100%. However, treatment integrity of the 10-trial sessions averaged 100% with IOA at 100% during PECS Phases 1 and 2. During PECS Phase 3, the treatment integrity was at high level, 94% with IOA at 100%. During maintenance conditions, the treatment integrity was at an average 0% with IOA at an average 100%. Treatment integrity during generalization sessions for Sameera was constant at an average of 0%, with IOA at 100% during all three PECS phases and during maintenance conditions. See Table 6.
Table 6

IOA and Treatment Integrity Scores for Sameera

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOA</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Treatment Integrity</td>
<td>0%</td>
<td>100%</td>
<td>100%</td>
<td>94%</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOA</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Treatment Integrity</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

John. During baseline conditions for John, treatment integrity measured in the 10-trial sessions averaged 0%, with IOA at 100%. Treatment integrity for the 10-trial sessions increased to 100% with IOA averaging 100% during PECS Phases 1 and 2. During PECS Phase 3, treatment integrity remained at a high level, 93%, with IOA at 100%. During maintenance conditions, the treatment integrity was 0% with IOA at 100%. Treatment integrity during generalization sessions for John was constant at 0% with IOA at 100% during all three PECS phases and during maintenance conditions. See Table 7.
Table 7

IOA and Treatment Integrity Scores for John

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IOA</strong></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Treatment Integrity</strong></td>
<td>0%</td>
<td>100%</td>
<td>100%</td>
<td>93%</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Generalization Sessions**

<table>
<thead>
<tr>
<th></th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IOA</strong></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Treatment Integrity</strong></td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

*Layan.* During baseline conditions for Layan, treatment integrity was 0%, with IOA at 100%. Treatment integrity of the 10-trial sessions increased to 100% with IOA at 100% during PECS Phase 1. During PECS Phase 2, treatment integrity was measured at a high level, 97%, with IOA at 97%. During Phase 3, treatment integrity increased to 100% with IOA at 100%. During maintenance conditions, treatment integrity was 0%, with IOA at average 100%. Treatment integrity during generalization sessions for Layan was constant at 0%, with IOA at 100% during all three PECS phases and maintenance conditions. See Table 8.
Table 8

IOA and Treatment Integrity Scores for Layan

10-trial sessions

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOA</td>
<td>100%</td>
<td>100%</td>
<td>97%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Treatment Integrity</td>
<td>0%</td>
<td>100%</td>
<td>97%</td>
<td>100%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Generalization Sessions

<table>
<thead>
<tr>
<th></th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOA</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Treatment Integrity</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
CHAPTER 5
DISCUSSION

The present study examined the efficacy of the use of PECS to teach requesting skills to students with multiple disabilities including visual impairment at the pre-Braille level. The questions specifically addressed whether these participants could learn to make requests for their preferred items using PECS with adaptations, and whether these participants could generalize requesting skills for preferred items using PECS with adaptations from training rooms to natural settings, e.g., their own classrooms.

Analysis of Results

Visual inspection of Figure 1 in Chapter 4, Results, shows that the mean of percentage of correct responses increased in each of the three PECS phases compared to the results obtained during baseline conditions. In addition, all four participants met the criterion for moving from one phase to the next, and all participants completed the three PECS phases and demonstrated high percentages of correct responses during the maintenance phases.

For the generalization sessions conducted inside the classrooms, results show that each participant performed at least one generalization session with a score of “Yes” for each phase of the PECS phases and during maintenance. These data regarding generalization sessions provide a degree of evidence that PECS skills were generalized from training rooms to the participants’ classrooms.
During baseline conditions, none of the participants responded correctly with the adapted PECS symbols. When the intervention was introduced in each of the three PECS phases, all participants greatly increased the percentage of correct responses and performed correctly at least one generalization session in each PECS training phase as well as during maintenance conditions. A clear functional relationship was established between the independent variables (the PECS training in each of the PECS phases) and the dependent variables (the percentage of correct responses and “Yes” or “No” scores during generalization sessions). These data provide strong support that PECS with adaptations was an effective program in teaching requesting skills for children with multiple disabilities including visual impairment.

Phase 3 was the most challenging phase for 3 of the 4 participants. This may be because the task in Phase 3 was more complicated than the tasks required in Phases 1 and 2. In Phase 3, the participant not only needed to hand a tangible symbol to a partner, but also had to choose the correct tangible symbol from two tangible symbols, one for a non-preferred item and another for a preferred item. In Phases 1 and 2, only one tangible symbol was placed in front of the participant and he/she was required to hand this symbol to a partner.

The difference between the two tangible symbols for the preferred and non-preferred items was the most important variable in Phase 3. When the two tangible symbols in Phase 3 were clearly differentiated by shape, color, and/or size, the tasks appeared easier for the participants to learn. When the two tangible symbols were more similar, the tasks appeared more difficult to master. For example, Sameera responded
correctly when using a certain preferred tangible symbol (i.e., a plastic banana to request a small bite of a banana), whereas she performed incorrectly when using another tangible symbol for another preferred item (i.e., a flattened piece of M & M package to request M & Ms). This continued until this second symbol was modified to be larger and more three-dimensional, therefore more accessible to this particular participant. See Table 2 and Appendix D for more information about specific tangible symbols.

On the other hand, Phase 2 was the most challenging phase for Layan. In Phase 2, the distance was increased from 1 foot to 2 feet. Layan, the only study participant with complete visual loss, needed more training sessions than the other participants to learn the required tasks. Specifically, Layan had to find the open hand of the partner in order to release the symbol into the partner’s hand, a seemingly more difficult task without any vision.

Interestingly, Layan did not have difficulties in completing Phase 3. In this case, the distracter was totally different than the other preferred tangible symbols. The distracter was a whole object of a Styrofoam cylinder (see Table 2 and Appendix D for more information about specific tangible symbols). By using her tactile abilities, Layan was able to easily recognize the Styrofoam distracter most likely because of its rough texture. Once Layan touched the textured Styrofoam, she quickly learned to avoid this meaningless and non-preferred symbol and was able to choose another tangible symbol, i.e., the one representing the preferred item.

Although there were some differences between the number of training sessions needed for each participant to reach the criterion in the three PECS phases, at the end of
this study, all four study participants completed all phases. In addition, the study participants demonstrated generalization by employing the trained skills in their own classrooms, and they maintained the trained skills for several data collection sessions after training.

**Relationship to Existing Literature**

To date, only one research study conducted by Lund and Troha (2008) was found regarding the use of PECS on teaching requesting skills to students with multiple disabilities including visual impairment at pre-Braille level. This present study expanded the application of an adapted PECS for teaching students with multiple disabilities including visual impairment. In addition, the findings of this study supported the existing literature presenting the positive effects of PECS with adaptations to teach requesting skills to students with multiple disabilities (Almeida et al., 2005; Ganz et al., 2005; Lund & Troha, 2008; Malandraki & Okalidou, 2007).

The purpose of this study was not only to expand the effectiveness of using PECS with adaptations to teach requesting skills to students with multiple disabilities including visual impairment, but also to address some of the limitations of past research, particularly Lund and Troha’s (2008) study. The limitations in Lund and Troha’s study were the following:

1. The use of only one preferred item with one corresponding symbol for each participant to teach requesting; whereas the present study used at least two preferred items with two symbols for each participant to teach requesting.
2. The PECS trainers used only verbal cues to teach requesting skills; whereas the present study employed individualized methods of enticement for each participant without using verbal prompting to teach requesting skills. The present study used physical prompting in PECS but this was accompanied with a fading procedure (i.e., verbal or physical prompting), and this study’s trainers also taught requesting skills without using any prompting at all.

3. The PECS trainers did not use an effective fading strategy for teaching independent responses based on the participants’ data; whereas the present study used effective, gradual fading strategies and backward chaining based on each participants’ data in this study.

Therefore, by overcoming some of the limitations in Lund and Troha’s research, the present study enhanced the effectiveness of PECS to teach requesting skills to the students with multiple disabilities including visual impairment.

Treatment Integrity

Because the intervention was applied over time in a single-subject design, documentation of adequate implementation fidelity is required and highly desirable (Horner et al., 2005). Treatment integrity of the study’s intervention was measured for approximately 30% of all sessions in each condition and each PECS phase. Treatment integrity was measured and scored by two trained secondary observers. Results indicated high levels of treatment integrity.
percentages providing evidence that the implementation was conducted with high fidelity.

Limitations

A limited number of research studies have examined the effectiveness of PECS on teaching students with multiple disabilities including visual impairment. This study included only four participants with multiple disabilities including visual impairment, considered a low-incidence population. Therefore, a large number of participants is not available.

This study provided evidence that the participants generalized the requesting skills to their classrooms. However, this study did not provide evidence of generalization of acquired skills in other environments such as the cafeteria, playground, or the participants’ homes. Therefore, examining the participants’ acquisition of PECS skills in other environments is not available.

When using the multiple probe design, it is important to show that the participants are functionally similar yet independent of one another. Although all participants met the selection criteria to participate in this study and all the participants’ performances during the baseline conditions averaged 0% correct responding, it is difficult to be certain that the participants are functionally similar because they are from a low-incidence population. The differences in the number of sessions to reach the criterion in each PECS phase, and the initial responses to the intervention might be referred to the individual differences of the participants’ skills and abilities such as, visual, physical and cognitive skills. The
present study provided evidence that the participants learned new requesting skills and they could generalize the trained skills to their classrooms. However, not incorporating PECS in the students’ daily programs limited the benefits of PECS as it was only applied in restricted circumstances and at certain times.

Finally, two PECS trainers, the classroom teachers, were only involved in training during PECS Phases 1 and 2, while the main PECS trainer, the PI, was involved in all training sessions. Because the PI conducted all training sessions, social validity data was not obtained from the classroom teachers. This lack of measurement of social validity is a limitation to this study. However, some interesting events occurred as the students neared the end of study providing support that the intervention was acceptable and desirable to the classroom teachers. For example, one of the classroom teachers, a PECS trainer, kept implementing the intervention with one participant even after the study was done; both classroom teachers, the two PECS trainers, requested guidance from the PI to continue the intervention after study completion.

Implications

The present study focused on establishing independent requesting skills to students with multiple disabilities including visual impairment. The participants had many challenges in communication. Based on the data, the participants’ requesting skills increased significantly and generalization skills in the natural settings of the classrooms were acquired. In addition, the participants maintained their acquired requesting trained skills for several sessions conducted after PECS training ended. Because PECS is
considered an augmentative and alternative communication system used with various environments and in different times (Frost & Bondy, 2002), service providers need to work collaboratively to incorporate PECS in the typical routine of the students and to provide opportunities to the students to communicate using PECS with different people.

The present study focused on teaching the basic skills of PECS. The participants learned to make a request with one preferred item using a corresponding symbol. The participants also learned to request 4-5 preferred items or activities. Further studies are needed to investigate the effectiveness of teaching advanced PECS skills and the use of tangible symbols for a larger number of preferred items and activities.

In this study, the participants learned only requesting skills, considered only a partial piece of overall communication. The PECS system was established primarily to teach requesting and commenting skills (Ostryn, Wolfe, & Rusch, 2008). However, training of communication skills includes teaching “wh” questions, the introduction of conversational vocabulary unrelated to requesting, and the implementation of eye gaze and joint attention skills. Therefore, rather than teaching just one area of a communication system like PECS, it is important for researchers and educators to incorporate PECS in a multi-modal communication system that allows people with disabilities to choose the most efficient system based on their situations (Ostryn, Wolfe, & Rusch). For example, using a voice output device that says “Please, I need help” to gain attention from another at a distance may be more efficient than using pictures or tangible symbols especially for students with physical disabilities; but, using pictures or tangible symbols to request preferred items or activities with someone close by may be
more efficient than using a voice output device. Therefore, PECS should be incorporated with other communication systems in order to achieve the most effective communicative functions for people with disabilities in varied situations.

PECS strategies are based on applied behavior analysis including the gradual fading of physical prompting, error correction, and reinforcement strategies. These procedures have been used systematically and effectively with students with disabilities. In the field of special education, specifically in teaching individuals with severe and multiple disabilities, the use of systematic instruction has been highly emphasized (Westling & Fox, 2009). The results of this study support the importance of using systematic instructional strategies. Although PECS is focused upon teaching communication skills, the broad implication is that the use of systematic instruction across all teaching areas is essential (Downing, 2005a). Teacher preparation programs must be held accountable to include these methodologies in their curricula.

Finally, the present study clearly demonstrated that PECS was used effectively by the participants during training and generalization sessions. The study indicated that the requesting skills of the participants maintained at a high level of correct responding during maintenance sessions conducted over one to four weeks after training completion. Continued assessment of the effectiveness of PECS over months and years remains a question for further research especially in teaching students with multiple disabilities including visual impairment. Clearly, additional studies will be needed to demonstrate that adapting PECS for this low incidence population is considered a research-based practice.
APPENDIX A. REINFORCER ASSESSMENT

Appendix A-1

Vocabulary Selection Worksheet

(Frost & Bondy, 2002)

Student/Child:
Person completing form:
Date:

Instructions: List up to 5-10 items for each category. Include only those items that your student or child currently enjoys (or dislikes for final category).

<table>
<thead>
<tr>
<th>Category</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Things your student/child likes to eat.</td>
<td></td>
</tr>
<tr>
<td>Things your student/child likes to drink.</td>
<td></td>
</tr>
<tr>
<td>Activities your student/child likes:</td>
<td></td>
</tr>
<tr>
<td>(e.g., watching television, spinning, sitting).</td>
<td></td>
</tr>
<tr>
<td>Social games your student/child likes (e.g., Peek-a-boo, being chased, being tickled.)</td>
<td></td>
</tr>
<tr>
<td>Places your student/child likes to visit.</td>
<td></td>
</tr>
<tr>
<td>What your student/child chooses to do during free time.</td>
<td></td>
</tr>
<tr>
<td>People your student/child recognizes and enjoys being with.</td>
<td></td>
</tr>
<tr>
<td>Items, activities your student/child DOES NOT like.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix A-2

Reaction to One Preferred Item

(Frost & Bondy, 2002)

<table>
<thead>
<tr>
<th>Item</th>
<th>Rejects</th>
<th>No reaction</th>
<th>Reaches for</th>
<th>Protests when taken away</th>
<th>Shows signs of pleasure</th>
<th>Takes again</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
## Appendix A-3

**Most Often Preferred Item**

*(Frost & Bondy, 2002)*

<table>
<thead>
<tr>
<th>Item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
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<tbody>
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</tbody>
</table>

**Key:**

- X = The item was offered to a participant but she/he did not select it.
- X+ = The item was offered to a participant and she/he selected it.
Appendix A-4

Ranking of Most Preferred Item

(Frost & Bondy, 2002)

<table>
<thead>
<tr>
<th>Preferred</th>
<th>Non-preferred</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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<td>5.</td>
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<tr>
<td>6.</td>
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</tbody>
</table>

Note: The evaluator writes the preferred items in an order based on the reinforcer hierarchy results.
APPENDIX B. TRIAL-BY-TRIAL DATA

Appendix B-1

Trial-by-Trial Data

(Frost & Bondy, 2002)

Phase 1

<table>
<thead>
<tr>
<th>Trial</th>
<th>Tangible symbol</th>
<th>Picks up</th>
<th>Reaches toward</th>
<th>Releases it into</th>
<th>Staff Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tbody>
</table>

Key:
+ = Independent
P = physical prompt

Comments: ______________________________________________________________
**Appendix B-2**

**Trial by Trial Data**

*Phase 2*

Student: _____________________           Date: ______________________

<table>
<thead>
<tr>
<th>Trial</th>
<th>Tangible Symbol</th>
<th>Picks up</th>
<th>Reaches Toward</th>
<th>Releases it into Hand</th>
<th>Distance (&lt; 1ft, 1-2 ft, 2ft)</th>
<th>Staff Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tbody>
</table>

Key:
+ = Independent  
P = Physical prompt  
Ft = Feet

Comments: ______________________________________________________________  
________________________________________________________________________  
________________________________________________________________________

Note: adapted from Frost & Bondy (2002).
Appendix B-3
Trial-by-Trial Data

(Frost & Bondy, 2002)

Phase 3

<table>
<thead>
<tr>
<th>Trial</th>
<th>Preferred item</th>
<th>Non-preferred item</th>
<th>Correct Choice or Error (+ or -)</th>
<th>Comments</th>
<th>Staff Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<tr>
<td>2</td>
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</tbody>
</table>

Key:
+ = Correct: selects the correct tangible symbol (preferred item)
− = Error: selects the wrong tangible symbol (Non-preferred item).

Go straight into error correction procedure.

Comments: ______________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
Appendix B-4

Generalization Session

Observer: _________________

Student: ____________  Date: _________________  Day: ______

Draw a circle around the student’s response:

Yes                                     No

Comments: ___________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
APPENDIX C

TREATMENT INTEGRITY

Baseline or generalization session

Observer: ________________  

Student: ________________  Date: ________________  Day: ________

<table>
<thead>
<tr>
<th>Component</th>
<th>Component integrity (1 or 0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Having a physical prompter (who sits behind or beside the student)</td>
<td></td>
</tr>
<tr>
<td>• The trainer uses hand-over-hand or hand-over-arm to physically guide the student to pick up, reach, and release a symbol into the trainer’s hand</td>
<td></td>
</tr>
<tr>
<td>• The trainer uses verbal prompt while enticing the preferred item to the student</td>
<td></td>
</tr>
<tr>
<td>• The trainer uses “Backstep Strategy” for error correction</td>
<td></td>
</tr>
</tbody>
</table>

Total of session integrity

Key:
1 = Implemented
0 = Not implemented
Phase 1

Observer: _________________

Student: ______________   Date: _________________ Day: ________

Communicative Partner

<table>
<thead>
<tr>
<th>Component</th>
<th>Component integrity</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Arranges training session, one tangible symbol will be placed on a table, slant board, or to a frame on a table in front of the student. The tangible symbol could be placed on a floor, or held on a frame depending on the situation of the training session.</td>
<td>(1, 0, or N)</td>
</tr>
<tr>
<td>• Uses “First one’s strategy” for each reinforcer used in the first time</td>
<td></td>
</tr>
<tr>
<td>• Entices appropriately with no verbal prompt</td>
<td></td>
</tr>
<tr>
<td>• Moves the tangible symbol on a table while enticing the preferred item (for students who can’t see the symbol on a table).</td>
<td></td>
</tr>
<tr>
<td>• Uses open hand prompt when the student either reaches to the symbol or item</td>
<td></td>
</tr>
<tr>
<td>• When the communicative partner takes the tangible symbol from the student, she or he should:</td>
<td></td>
</tr>
<tr>
<td>• Praise the student</td>
<td></td>
</tr>
<tr>
<td>• Give the preferred item within ½ second</td>
<td></td>
</tr>
<tr>
<td>• Returns the tangible symbol to a table or to a frame on the table (while the student consumes or plays with preferred item)</td>
<td></td>
</tr>
</tbody>
</table>
- The distance between the communicative partner’s hand and the body of the student is almost 1 foot or less.

**Physical prompter**

<table>
<thead>
<tr>
<th>Physical Prompting</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wait for the student to reach for the preferred item</td>
<td></td>
</tr>
<tr>
<td>Uses hand over hand or hand over arm to physically guide to pick up, reach, and release a symbol into the trainer’s hand</td>
<td></td>
</tr>
<tr>
<td>Fades physical prompting by using a backward chaining</td>
<td></td>
</tr>
<tr>
<td>Prevents student’s interfering behaviors</td>
<td></td>
</tr>
<tr>
<td>Uses “Backstep Strategy” for error correction</td>
<td></td>
</tr>
</tbody>
</table>

**Key:**
1 = Implemented nearly all the time
0 = Not implemented
N = Not applicable
**Phase 2**

*Observer: ___________________*

*Student: _____________  *Date: _______________  *Day: ________

*Communicative partner*

<table>
<thead>
<tr>
<th>Component</th>
<th>Component integrity (1, 0, or N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Arranges of the training session, attaches one tangible symbol via Velcro to the cover page of the communication book. The communication book could be placed on a table, on a floor, or held by the trainer depending on a situation.</td>
<td></td>
</tr>
<tr>
<td>• No verbal prompt</td>
<td></td>
</tr>
<tr>
<td>• Uses “First One’s Strategy” for the preferred item used in the first time</td>
<td></td>
</tr>
<tr>
<td>• Entices appropriately based on the student’s recognition</td>
<td></td>
</tr>
<tr>
<td>• When the communicative partner takes the tangible symbol, she or he should</td>
<td></td>
</tr>
<tr>
<td>• Praise the student, and</td>
<td></td>
</tr>
<tr>
<td>• Give the preferred item within ½ second</td>
<td></td>
</tr>
<tr>
<td>• Attaches again one tangible symbol via Velcro to the cover page of the communication book (while the student consumes or plays with the item)</td>
<td></td>
</tr>
<tr>
<td>• Moves slightly further back from the student in each next trial, by inch or inches each time (until 2 feet or more)</td>
<td></td>
</tr>
</tbody>
</table>
Physical prompter

- Waits for the student to reach for the tangible symbol
- Provides hand over hand for removing the tangible symbol from the communication book, if necessary
- Provides hand over hand for reaching the student to the communicative partner’s hand, if necessary
- Provides hand over hand for releasing the tangible symbol into partner’s hand, if necessary
- No social interaction with the student
- Uses “Backstep Strategy” for error correction

Key:
1 = Implemented nearly all the time
0 = Not implemented
N = Not applicable
Phase 3

*Observer:* 
*Student:* 
*Date:* 
*Day:* 

**Communicative partner**

<table>
<thead>
<tr>
<th><strong>•</strong> Arranges for environment, two tangible symbols will be attached to the cover page of the communication book (one for preferred item and another for non-preferred item) on a table.</th>
</tr>
</thead>
</table>
| **•** Entices appropriately with two items  
The trainer can entice with one preferred item  
if the distracter is “Blank symbol”. |
| **•** Puts the participant’s hands on both tangible symbols, if necessary |
| **•** Socially praises the student as soon as the student removes the correct tangible symbol from the communication book |
| **•** When the communicative partner takes the tangible symbol, the communicative partner should:  
  ➢ Praise the student  
  ➢ Give the preferred item to the student within ½ second |
<p>| <strong>•</strong> Returns the tangible symbol to the cover page of the communication book (while the student consumes or plays with the preferred item) |</p>
<table>
<thead>
<tr>
<th>Conducts error correction procedure correctly</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Gives non-desired item</td>
</tr>
<tr>
<td>➢ Elicits negative response</td>
</tr>
<tr>
<td>➢ Model</td>
</tr>
<tr>
<td>➢ Prompt</td>
</tr>
<tr>
<td>➢ Turn the book over and return back</td>
</tr>
<tr>
<td>➢ Repeat</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rearrange the tangible symbols after each correct trial</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>No insistence on speech</th>
</tr>
</thead>
</table>

Key:
1 = implemented nearly all the time
0 = not implemented
N = not applicable
APPENDIX D

PHOTOS OF THE PARTICIPANTS’ TANGIBLE SYMBOLS

Stephanie’s Tangible Symbols

Sameera’s Tangible Symbols
John’s Tangible Symbols

Layan’s Tangible Symbols
REFERENCES


References (continued)


References (continued)


References (continued)


References (continued)
