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Effects of Mother-Implemented Picture Exchange Communication System (PECS) Training on Independent Communicative Behaviors of Young Children With Autism Spectrum Disorders

Ju Hee Park1, Sheila R. Alber-Morgan2, and Helen Cannella-Malone3

Abstract
This study examined the effects of mother-implemented Picture Exchange Communication System (PECS) training on the independent communication of three young children with autism spectrum disorders. Three mothers were trained to teach their child PECS Phases 1 through 3B, which they did with high integrity. Moreover, all three children successfully acquired independent picture exchanges that were generalized to a different communication partner and maintained for at least 1 month. Vocalizations across participants showed limited or no improvement. These findings systematically extend previous PECS research by training mothers to be the primary implementers of PECS training. In addition, this research provides practitioners with insight into the feasibility and necessity of parent-implemented PECS training.

Keywords
picture exchange communication system (PECS), mother-implemented training, autism spectrum disorders (ASD), parent training, early childhood

The Picture Exchange Communication System (PECS, Bondy & Frost, 1964), an aided augmentative and alternative communication (AAC) system, uses pictures to help young children with autism spectrum disorders (ASD) who are not communicating to engage in spontaneous communication (Bondy & Frost, 2001). Unlike other AAC systems or approaches to speech training, which begin with teaching children to label or name objects, PECS begins by teaching children to request preferred items or activities as reinforcers—rather than social reinforcers—because children with ASD may be less sensitive to social consequences (Bondy & Frost, 1991).

During the past 15 years, PECS has gained attention as a potential AAC system for children with ASD. Researchers have made efforts to provide empirical data that demonstrate the effectiveness of PECS, and the results have generally suggested that PECS may improve the communication skills of young children with ASD within a relatively short period of time (e.g., Atkins & Axneld, 2003; Bondy, 2000; Carr & Felice, 2007a; Carr & Felice, 2007b; Carr & Stone, 2006b; vocal imitation; Charlop-Christy, Carpenter, Lai & Kelleher, 2002), and the complexity or length of utterances (Ganz & Simpson, 2004; Jurgens, Anderson, & Moore, 2009; Travis & Geiger, 2010). These effects of PECS on vocalizations may be partly explained by the combined use of concrete items, visual pictures, and spoken words during PECS training (Carr & Felice, 2007c).

With few exceptions (e.g., Ganz, Simpson, & Cortina-Newman, 2008), it seems that PECS may be an effective AAC system for improving the spontaneous communication of children with ASD. Nonetheless, there are several limitations that need to be addressed in order to substantiate the effectiveness and efficiency of PECS. First, only a few studies (e.g., Ben Caspian, Alber-Morgan, & DeBart, 2009; Mokeler, Neff, & Ferree, 2004; Yoder & Stone, 2006a, 2006b) have assessed the procedural integrity of PECS.

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training, providing evidence on the training accuracy. Although PECS provides a structured and systematic protocol that may have helped in the accurate implementation of PECS training by professionals in previous studies, this does not guarantee that all PECS implementers followed the protocol rigorously. To ensure that children's improvements in communication skills truly result from PECS, treatment fidelity of PECS training must be established. Second, only a relatively small number of studies (e.g., Ben-Chaabane et al., 2009; Cammisa-Malone et al., 2010; Marckel et al., 2006; Timpani, 2004; Yoder & Stone, 2009a, 2009b) have assessed the acceptability or feasibility of PECS from the perspective of the parents, who often use PECS with their child following training. However, the goals, procedures, and effects of a behavioral intervention should be significant and acceptable from the perspective of its customers and the society (Weisz, 1978). For early intervention, the extent to which parents accept any intervention for their young children is particularly critical in that their satisfaction will influence the continued use of the treatment (Reimers, Walker, & Cooper, 1992). Thus, to better substantiate the effectiveness of PECS, it is necessary to conduct further research in which social validity data on its feasibility and acceptability are assessed from the perspective of the parents.

Third, one possible way to maximize the effectiveness of PECS may be by providing children with as many opportunities to practice the picture exchange as possible in natural settings. It may be possible to increase these opportunities by training parents to implement PECS at home, because they are likely to spend a lot of time with their child. To date, there is no identified research that trained parents are the primary PECS trainer and examined the effects of parent-implemented PECS training on children's communication skills. Although Ben-Chaabane et al. (2009) taught mothers how to conduct improvisation training with their child using PECS, their focus was on extending the reach of improvisation training, not on using parents as the primary trainer from the onset.

Training parents to be primary PECS trainers will have several benefits for children with ASD because children spend much of their time at home. In particular, interventions provided by professionals are typically quite expensive (Sharpe & Baker, 2007). If parents were taught to conduct PECS in the same way as professionals, children with ASD may obtain more consistent benefits from PECS without extra costs. In effect, researchers have reported that parents with children with ASD could successfully be trained to teach their child communication interventions such as Enhanced Milestone Teaching (Kaiser, Hanceck, & Neufeld, 2000) and Reciprocal Instruction Training (Ingersoll & Gurganus, 2007). Kaiser et al. and Ingersoll and Gurganus also found that parent-implemented interventions significantly improved the targeted communicative responses of children. In this respect, it is important to investigate whether parents can serve as PECS trainers for their child and explore what effects parent-implemented PECS training may have on young children with ASD. Therefore, the purpose of this study was to investigate the effects of mother-implemented PECS training on communicative behaviors of young children with ASD. Specifically, the research questions were as follows: (a) What effects does mother-implemented PECS training have on independent picture exchanges of young children with ASD? (b) What effects does mother-implemented PECS training have on word vocalizations of young children with ASD? and (c) To what extent are the mothers satisfied with the intervention and outcomes?

Method

Participants and Setting

Three children with ASD and their mothers participated in the study. All of the participants were recruited from an autism center affiliated with a children's hospital in a metropolitan city and met the following criteria: all three children (a) were diagnosed with ASD by the hospital, (b) were between the ages of 2 and 3, (c) had no or limited verbal language and were recommended for an AAC system, and (d) had not had PECS training. In addition, the mother had to have no previous experience learning how to teach PECS.

Ted was a Caucasian male with a diagnosis of pervasive developmental disorder—not otherwise specified and was 2 years 6 months old at the beginning of the study. Ted’s score on the Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Renner, 1984) was 33.5, which was in the mild—moderate autistic range. The CARS was completed by each mother and then scored by the experimenter. Ted’s mother was a 33-year-old Caucasian with one child. She was enrolled in an integrated bachelor’s/master’s-degree program and was a stay-at-home mother. Eric was an Indian American male with diagnosis of autism and a language disorder and was 2 years 7 months old. He received a score of 37.5 on the CARS completed by his mother, which was in the severe autistic range. Eric’s mother was a 35-year-old Indian American with a master’s degree who was a stay-at-home mother with two children—one daughter and one son. Bill was a Caucasian male diagnosed with autism. He was 2 years 6 months old and was scored 48 on the CARS completed by this mother, which was in the severe autistic range. Bill’s mother was a 33-year-old Caucasian with a master’s degree who had a part-time job. She had three children. All of the three children had no or limited verbal repertoire, and their primary way to request a desired item or activity was gestural (e.g., pointing, taking his parents by the hand).
All experimental sessions occurred in a quiet place in each child’s home according to the space availability of each family and the accessibility to the preferred item or activity used for training. With the permission of each mother, the experimenter videotaped all experimental sessions for data coding.

**Materials**

During mother-training sessions, video clips were provided to help each mother understand the PECS training procedures. The models showed three possible scenarios (i.e., the child engaging in a correct response, an incorrect response, or no response) and demonstrated how to respond to each scenario.

Individually identified preferred items and activities were used as reinforcers for the children. The PECS communication book, which included Velcro strips on the cover and laminated picture cards (2" x 2") of preferred items or activities, was also used. Each picture was either a line drawing or digital photograph.

**Definitions and Measurement of the Dependent Variables**

- **Child’s independent picture exchange**: An independent picture exchange was defined as exchanging a picture corresponding to a preferred item without any prompts (i.e., completing the behavioral objective of Phase 3B). Specifically, a complete independent picture exchange involved retrieving the communication book, selecting the correct picture, picking it up, reaching for the communication partner, releasing the picture into the partner’s hand, and choosing the correct item when two preferred items were provided for correspondence check. The independent picture exchange was broken into the aforementioned steps (see Table 1) because the behavioral objective of each phase was designed to gradually move toward the study’s terminal behavior (i.e., Phase 3B).

- **Independent picture exchanges**: The percentage of independent picture exchanges per session, which was calculated as follows. First, the number of trials in which the child independently completed all of the steps included in the corresponding phase’s task analysis (see Table 1) was counted. Second, the number of completed trials was then divided by 10 (i.e., the number of trials per session) and multiplied by 100%. Finally, this percentage was weighted by multiplying the weight of the steps for that phase (i.e., 3/6 for Phase 1, 4/6 for Phase 2, 5/6 for Phase 3A, and 6/6 for Phase 3B). For instance, if the child completed all three steps of Phase 1 without any prompts in 9 of 10 trials during one session, the percentage of independent picture exchanges in that session was 45% (i.e., 9/10 x 100% x 3/6).

**Table 1. Task Analysis for Determining Necessary Steps of Each Phase of PECS**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Step</th>
<th>Number of steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>1. Pick up the picture of a preferred item</td>
<td>3/6</td>
</tr>
<tr>
<td></td>
<td>2. Reach toward the communication partner</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Release the picture into the communication partner’s hand</td>
<td></td>
</tr>
<tr>
<td>Phase 2</td>
<td>1. Go to the communication book 5 ft away from him</td>
<td>4/6</td>
</tr>
<tr>
<td></td>
<td>2. Pick up the picture of a preferred item from the book</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Go to the communication partner 5 ft away from him</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Release the picture into the communication partner’s hand</td>
<td></td>
</tr>
<tr>
<td>Phase 3A</td>
<td>1. Go to the communication book 5 ft away from him</td>
<td>5/6</td>
</tr>
<tr>
<td></td>
<td>2. Select the correct picture of a preferred item</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Pick up the picture from an array</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Go to the communication partner 5 ft away from him</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Release the picture into the communication partner’s hand</td>
<td></td>
</tr>
<tr>
<td>Phase 3B</td>
<td>1. Go to the communication book 5 ft away from him</td>
<td>6/6</td>
</tr>
<tr>
<td></td>
<td>2. Select the correct picture of a preferred item</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Pick up the picture from an array</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Go to the communication partner 5 ft away from him</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Release the picture into the communication partner’s hand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Choose the correct item during correspondence check</td>
<td></td>
</tr>
</tbody>
</table>

*Abbreviations: PECS, Picture Exchange Communication System.*

**Child’s word vocalizations.** Word vocalizations included word utterances and word approximations. A word utterance was defined as the child clearly saying the name of the item or activity he requested during a trial. A word approximation was defined as the child making any vocalizations that did not exactly match the name of the requested item or activity but included at least one consonant and one vowel (e.g., Action for action). The percentage of both word utterances and word approximations was calculated by dividing the number of trials in which a word utterance (or word approximation) occurred by the total number of trials and multiplying by 100%.

**Interobserver agreement (IOA).** IOA on the dependent variables measure was assessed by two independent observers, the first experimenter and a second observer who was trained on the definition and measurement of the dependent
variables. The two observers independently recorded randomly selected sessions across participants and probe conditions for at least 27% (range 25%-38%) of sessions. IOA was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. With regard to IOA on independent picture exchange measures, IOA for Todd was consistently 100% across all conditions, except during maintenance, in which IOA was 98.4%. For Eric, IOA was consistently 100% across all conditions, with the exception of generalization, in which IOA was 98.3%. For Bill, IOA was 100% across all conditions with the exception of Phase 3, in which IOA was 98.3%. On the other hand, IOA on word utterances and approximations was consistently 100% across all conditions and participants.

**Experimental Design**

A changing criterion design (Coyne, Horn, & Haw ard, 2007) was used to demonstrate the effects of mother- implemented PECS training on children's independent picture exchanges. For several reasons, this design was selected over other experimental designs. The main reason was that PECS training was designed to teach independent picture exchanges in a stepwise manner. That is, each phase of PECS has its own objective, which is the prerequisite for achieving the objective of the next phase. In addition, all the experimental sessions of this study were implemented at each child's home, which made it impossible to maintain the training condition identical across participants. Thus, it was assumed that a multiple baseline across participants design does not warrant sufficient experimental control for the study. With the changing criterion design, the experimental control was demonstrated by the stepwise change in independent picture exchanges and subsequent stability corresponding to the change in mastery level.

The criteria for each phase were created using task analyses based on the objective of each phase of PECS. As described above, each phase included a different number of steps, ranging from three (Phase 1) to six (Phase 3B). To move from one phase to the next, the child was required to complete all of the required steps of each phase in 80% or greater of trials across two consecutive sessions. When weighted, the mastery level was 40% for Phase 1, 53.3% for Phase 2, 66.7% for Phase 3A, and 83% for Phase 3B.

**Procedures**

*Preference assessment.* A formal preference assessment was conducted at the beginning of this study to identify potential reinforcers for each child. Based on each child's responses to the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD; Fisher, Piazza, Bowman, & Amati, 1996), a Multiple-Baseline Without Replacement Preference Assessment (MSWO; DeLeon & Iwata, 1996), which included three to six items, was performed. During this assessment, stimuli were presented in an array, and the child was instructed to choose one. After a selection was made, the child could consume or engage with the item for 10 to 15 s. Following engagement, the array was represented with the previously selected item excluded. The array was presented until all items had been selected. In addition, brief preference assessments were conducted during each session throughout the study by asking the child to choose one item among several ranked high in the preference list.

*Mother training.* A mother-training session was implemented with each mother at her home without her child prior to baseline and each phase of PECS training. The experimenter who had sufficient knowledge of and proficiency in PECS conducted mother-training sessions, each of which lasted for 40 to 60 min. For Phases 1 and 2, both of which required two trainers (i.e., a communication partner and a physical prompter), the mother was trained to serve as the communication partner. Specifically, the mother was trained to initiate each trial by presenting preferred item(s) and picture(s), provide the appropriate consequence (e.g., allowing access to the item, turning the item, pointing, conducting error correction procedures), and conclude the trial. Each mother-training session lasted 40 to 60 min. The first experimenter provided the mother with written guidelines for each phase, explained the details of how to conduct each step in each phase, modeled the procedure, and showed a video clip in which an adult model conducted the procedures. The experimenter also answered any questions that the mother had. Subsequently, the mother was asked to practice the procedures until she reached at least 90% accuracy across three consecutive trials. During the practice sessions, the experimenter took the child's role, observed the mother, and provided feedback when necessary.

*Baseline.* Following the mother-training session for baseline, the mother conducted baseline sessions with her child. Two pictures that corresponded to the preferred items were placed on the cover of the communication book, which was 5 ft away from the child. The mother, who sat 5 ft away from the child, presented two preferred items without any verbal prompt. If the child initiated reaching for a picture within 10 s and exchanged it, the mother was asked to conduct the corresponding exchange by presenting the two items to the child and saying, *Take it.* (No child ever initiated an exchange in baseline.) If the child released a picture—regardless of whether or not the picture was picked up—the mother was asked to allow him to consume a small amount of the edible item or to access the tangible...
item for approximately 30 s. If the child reached for an item or activity without a picture exchange within 10 s, the mother also allowed the child to access the item or activity without any comment. In both cases, after the child accessed the item or activity, his mother ended the trial and introduced the next trial by rearranging the two items and their pictures. If the child made no attempt to reach for an item, activity, or a picture within 10 s, that trial was marked as incorrect, and the next trial was initiated.

PECS training. During PECS training, the mother taught her child phrases 1 through 3B as described in the PECS manual (Frost & Bondy, 2002). Specifically, the child was taught how to exchange a picture (Phase 1), spontaneously exchange a picture for requesting despite the increased distance from both the communication partner and the book (Phase 2), and discriminate a correct picture and exchange it when a preferred and a nonpreferred item or activity were presented (Phase 3A) and when two preferred items or activities were presented (Phase 3B). During sessions where the mother was training her child, the experimenter provided a prompt or feedback on the mother's implementation of the training procedures, if necessary. In addition, during Phases 1 and 2 training sessions that the PECS manual requires two adult trainers, the experimenter provided physical prompts to the child. Each session began with a brief preference assessment and consisted of 10 trials of picture-exchange. Training sessions of each phase continued until the child independently completed all of the required steps in 80% or more trials across two consecutive acquisition probe sessions. The number of training sessions provided for Phase 1 was four, two, two, and two for Phases 1A, 1B, 2, and 3A, respectively; three, three, four, and four for each; two, two, nine, and nine for Phase 1B.

Phase 1. The mother initiated the first trial by presenting her child with a preferred item in front of him and the corresponding picture slightly out of reach of him without any verbal prompt. When the child began to reach for the item, the experimenter, who was behind the child, immediately provided physical assistance to the child to exchange a picture. The physical assistance was gradually faded with backward chaining. As soon as the child released the picture into his mother's hand, the mother provided the item with verbal praise while simultaneously naming the item (e.g., “Good job! You asked for the cookie.”). Once the child independently removed the item from the book cover and released it into his mother's hand, the distance between the child and his mother and between the child and the book gradually increased up to 5 ft. First, the mother slightly increased the distance from her child if the child showed the correct response on one trial (i.e., by 1 ft per trial). If the child successfully approached his mother for 5 ft for a picture exchange, the distance between the child and the book was gradually increased by 1 ft per trial up to 5 ft using the same criteria as with distances from the mother. Finally, the child had to independently travel up to approximately 5 ft to get the picture, detach it from the book, go to his mother at a distance of 5 ft, and release the picture into his mother’s hand. During training sessions, physical prompts were delivered by the experimenter, if necessary, and gradually faded as in Phase 1.

Phase 2. No verbal prompts were provided. Other training procedures were the same as those in Phase 1.

Phase 3A. Discrimination training began by presenting a highly preferred item/activity, a nonpreferred item/activity, and two corresponding pictures placed on the book cover during Phase 3A. Unlike the previous phases, the mother offered the corresponding item/activity immediately after her child touched the correct picture instead of delaying the delivery of the reinforcement until the child released the picture. The mother also provided verbal praise and named the item/activity (e.g., “Good job! You chose the cookie.”). If the child touched the nonpreferred item picture, the mother gave the nonpreferred item/activity to her child. When the child received a nonpreferred item/activity and became upset, the mother implemented the four-step error correction procedure as follows: modeling, prompting, switching, and repeating. First, the mother modeled the correct response by touching the picture of a preferred item from the PECS book, moving to the child, and naming the item. Second, she physically prompted her child to pick up the correct picture (e.g., holding an open hand near the correct picture or pointing to it) and allowed the child to hand it to her. When the child completed the picture exchange, the mother provided verbal praise but not the item. If the child still failed to give the correct picture after the second attempt to fix the error, his mother ended the trial by rearranging the cover of the communication book using only the correct picture. This allowed the child to make the correct response. Once the child was able to discriminate and exchange a correct picture, the distance between the child and his mother and between the child and the book increased up to 5 ft in the same way as Phase 2. Phase 3 training continued until the child was able to discriminate at least three
different pictures and independently retrieve a picture from his book from 5 ft and exchange it with his mother who was 5 ft away.

Phase 3B. The same procedures were conducted as described in Phase 3A except that two preferred items with corresponding pictures were presented on each trial. In addition, as a way to ensure that the child selected the correct picture of the item he actually wanted to obtain between the two preferred item pictures, the mother implemented the correspondence check. That is, right after the child handed a picture to his mother, the mother presented both preferred items at the same time in front of her child and asked him to select the corresponding item, saying, “Good Take it.” The mother praised her child, named the item, and delivered it to her child as soon as he touched the correct item. If the child reached for the incorrect item in the correspondence check, the mother stopped him from accessing it and then implemented the error correction procedure in the same manner as described above. As in Phase 3A, the distance from the child to his mother and the book increased up to 5 ft following correspondence training.

Acquisition. An acquisition probe session was conducted when the experimenter arrived at the child’s home, prior to a training session, to determine whether the child could independently complete the steps of a given phase of PECS. Each acquisition probe session consisted of 10 trials, and the procedures were identical to those of a training session in each phase, except that no physical prompts or error correction were given if the child failed to independently exchange a picture. When the child reached mastery across two consecutive acquisition probe sessions, a generalization probe session was implemented either that day or on the next day.

Generalization. Generalization probes were implemented to evaluate whether the child could generalize the behavior learned during a given phase of PECS to a different communication partner. Each session consisted of 10 trials, and the procedures were identical to those of the acquisition probe condition of each phase, except the first experimenter took the mother’s role and served as the communication partner.

Maintenance. Maintenance probe sessions were performed to determine whether the child maintained the terminal behavior following intervention. Maintenance data were collected once a week for 1 month. The procedures were identical to acquisition probe procedures of Phase 3B.

Procedural Integrity

The fidelity with which the mother and experimenter implemented each condition was measured using checklists specific to the condition. For the mother’s procedural integrity, at least 61% (range 61%–75%) of sessions were randomly selected across participants. The experimenter’s procedural integrity for mother training, Phase 1 and 2 training, and generalization sessions was calculated from 25% of sessions across conditions for each child. Procedural integrity was calculated by dividing the number of correctly implemented steps by the total number of steps and multiplying by 100%. Procedural integrity averaged 99.7% (range 98%–100%) for Tad’s mother, 99.6% (range 98%–100%) for Tad’s mother, and 99.6% (range 95%–100%) for Bill’s mother. During the training sessions, the experimenter provided prompts or feedback to the mother when she implemented a step incorrectly. The mothers received very few prompts or feedback statements while training their child (M = 0.6, range 0–3). In addition, the experimenter implemented all procedures with 100% integrity.

IOA on procedural integrity measures was assessed by computing accuracy and correctly implemented steps, which were independently recorded by two observers and computed by dividing the number of agreements by the number of agreements plus disagreements and then multiplying by 100%. Mean IOA on procedural integrity was 99.5% (range 97.6%–100%) for Tad’s mother, 99.6% (range 96.7%–100%) for Tad’s mother, and 99.5% (range 95.7%–100%) for Bill’s mother. IOA on the experimenter’s integrity measure was 100%.

Social Validity

A social validity questionnaire, which was developed by the experimenter, was distributed to the mothers to assess the extent to which they found the goals, procedures, and outcomes of the intervention acceptable (see Table 2 in discussion for the specific questions). The questionnaire consisted of nine questions that asked the mother to respond to a 5-point Likert-type rating scale. The higher the rating score, the more the mother was satisfied with the goals, procedures, and outcomes of the study. Specifically, the questionnaire contained questions regarding the importance of goals to teach children with autism spectrum disorders PECS as an alternative way for communication and to train mothers to teach their child PECS. There were also questions regarding the feasibility of mothers being taught to teach their child PECS and using PECS with their child in home settings. In addition, questions about the mother’s perception of progress in her child and her satisfaction with the improvement were included.

Results

Children’s Independent Picture Exchanges

Figure 1 displays the percentage of independent picture exchanges completed by Tad during baseline, acquisition,
Table 2. Results of the Social Validity Assessments (M = 3)

<table>
<thead>
<tr>
<th>Questions</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How meaningful do you think it is to teach the picture exchange skill to children with autism as an alternative way for communication?</td>
<td>5</td>
</tr>
<tr>
<td>2. How important do you think it is for mothers to teach their child with autism to use the PECS at home?</td>
<td>5</td>
</tr>
<tr>
<td>3. How much do you think mothers can successfully teach their child the PECS when they have opportunities to learn how to teach children to use it?</td>
<td>5</td>
</tr>
<tr>
<td>4. How feasible would it be for you to use the PECS with your child at home?</td>
<td>5</td>
</tr>
<tr>
<td>5. How comfortable did you feel when teaching your 4.7 (5-5) child to use the PECS?</td>
<td>5</td>
</tr>
<tr>
<td>6. My child learned picture exchange as a mean of communication during the study.</td>
<td>5</td>
</tr>
<tr>
<td>7. My child made meaningful progress as a result of participating in this study.</td>
<td>5</td>
</tr>
<tr>
<td>8. I would be likely to use the PECS after this study.</td>
<td>5</td>
</tr>
<tr>
<td>9. I would recommend mothers with children with autism to teach their child the PECS.</td>
<td>5</td>
</tr>
</tbody>
</table>

*Abbreviation: PECS, Picture Exchange Communication System. Parentheses indicate the range of the scores.*

Figure 1. Percentage of independent picture exchanges during baseline, acquisition, generalization, and maintenance probe sessions for Tad.

Figure 2. Percentage of independent picture exchanges during baseline, acquisition, generalization, and maintenance probe sessions for Eric.

taught in each phase to a different communication partner throughout all four phases when his mother was unavailable. Tad required 10 training sessions to master all four targeted phases and maintained the terminal behavior at 100% for 1 month.

Results presented in Figure 2 show that Tad made gradual progress toward the terminal behavior. Prior to PECS training, Eric displayed no independent picture exchanges during baseline. When training was introduced, the mean percentage of independent picture exchanges was 45% (range 35%-50%) for Phase 1 and 55.6% (range 46.7%-66.7%) for Phase 2. During Phases 3A and 3B, variability in this data was observed, with a mean percentage of 64.8% (range 41.7%-83.3%) for Phase 3A and 65% (range 30%-100%) for Phase 3B. As shown in the generalization probe data, the percentage of independent picture exchanges by Eric to a different communication partner was 50% for Phase 1, 85% for Phase 2, 83.3% for Phase 3A, and 90% for Phase 3B. Tad mastered all the phases within 14 sessions and maintained the terminal behavior with a mean percentage of independent picture exchanges of 97.3% (range 90%-100%).

As shown in Figure 3, Bill engaged in no independent picture exchanges during baseline. When Phase 1 training was conducted, an immediate increase in independent picture exchanges was observed (M = 45%, range 40%-50%) and continued in Phase 2 (M = 63.4%, range 60%-66.7%). During Phases 3A and 3B, there was variability in the percentage of independent picture exchanges, with a mean percentage of 63.3% (range 50%-83.3%) for Phase 3A and 78.3% (range 60%-100%) for Phase 3B. Generalization probe data show that once he mastered a given phase with his mother, he successfully generalized the mastered behavior to a different communicative partner (e.g., 50% for Phase 3A and 83.3% for Phase 3B).
Figure 3. Percentage of independent picture exchanges during baseline, acquisition, generalization, and maintenance probe sessions for IE.

1. 60% for Phase 1, 75% for Phase 3A, and 90% for Phase 3B. Bill mastered all the phases within 22 sessions and maintained 100% independent picture exchanges for 4 weeks following intervention.

**Children’s Word Vocalizations**

For Eric, no word utterances occurred during baseline, acquisition, or generalization probes during Phases 1, 2, or 3A. He began to emit word utterances during Phase 3B, clearly saying “Toy” when he released the picture to his mother (M = 5/5, range 0%-10%), and during maintenance probe sessions, saying “Toy” and “Raise” (i.e., 10% per session). No word approximations were observed. For Eric, neither word utterances nor word approximations occurred until maintenance probes were being conducted, when he approximated “keep” in the first maintenance session (i.e., 10%). Bill did not engage in any word utterances or approximations throughout the study.

**Social Validity**

Social validity data revealed that the mothers were very satisfied with the goals, procedures, and outcomes of the study. As Table 2 shows, all three mothers rated the goals of teaching children PECS and training mothers to teach their own child PECS as very important (M = 5). They strongly believed that their child PECS if they learned how to teach PECS (M = 5). They also perceived that it was very feasible to teach PECS with their child at home (M = 5) and felt either somewhat or very comfortable in teaching their child to use PECS (M = 4/7, range 4–5). In terms of outcomes, each mother strongly agreed that their child learned to use the picture exchange as a way to communicate (M = 5) and exhibited significant improvement during the study (M = 5). They reported that they were very willing to use PECS after the study (M = 5). In addition, all three mothers responded that they would strongly recommend other mothers with children with autism to teach their child PECS (M = 5).

**Discussion**

Results from the present study demonstrate that three young children with autism spectrum disorders could be taught by their mothers to communicate using PECS and maintain the trained skill for at least 1 month. In addition, all three children were able to generalize their communication skills to a different communication partner. Only two of the three children demonstrated word vocalizations across approximations at the end of the study. The results suggest that with 40 to 60 min of training per phase (through Phase 3B), mothers can be taught to implement PECS training with high fidelity and that they found the methods to be highly socially valid.

These findings replicate those obtained from previous studies that reported that most of the children acquired PECS skills effectively when professionals implemented PECS training (e.g., Anderson et al., 2007; Caruso-Chantry et al., 2001; Kravitz, Kampp, Kammerer, & Pompeck, 2002). The current study extends the existing research on PECS both by teaching mothers as the primary PECS trainer and demonstrating the positive impact of PECS on very young children (i.e., 2.4–2.6 years old). Moreover, all the three mothers anecdotally reported that their child used PECS with one or more other family members (e.g., father, grand mother) outside of the experimental sessions, suggesting that the children used PECS skills as a way of functional communication in their natural setting. These positive outcomes may be ascribed to the following aspects of the intervention. Primarily, the mother-implemented intervention prevented the children from having difficulties establishing a rapport with an unfamiliar therapist, which may have facilitated their rapid acquisition of the target behavior. Furthermore, all the three mothers taught their child PECS with high levels of integrity across phases.

The procedure employed for mother training, which was a combination of several different components such as written guidelines, verbal explanations, video clips, in vivo modeling, practice, and immediate feedback, may have been effective in teaching the mothers how to implement PECS. In addition, all of the children were young and had no established challenging behaviors that functioned as a mode of communication, which may have influenced their acquisition of PECS.

In addition, individual differences were observed in the number of sessions required for the mastery of all the four phases, which ranged 10 to 22 sessions. This difference
may have resulted from characteristics of each child. The
cognitive ability, extent to which each child was sensitive to
social consequences, and attention skills to look at the pic-
tures to select the correct one may have influenced chil-
dren's independent picture exchange outcomes. Further
research could identify which factors facilitate or impede
children's improvement in using Pecs.

Although the data on word utterances and approxima-
tions appear negligible, the patterns match those of previ-
sion researchers, which have found delayed emergence of
speech during Pecs training (Charpin-Christia et al., 2002;
Ganz et al., 2008; Ganz & Simpson, 2004). It is possible
that if the training had continued beyond Phase 3R, more
spontaneous vocalizations would have been observed.
More exposure might be required prior to the emergence of
word vocalizations during the picture exchange, as children
may need time to incorporate a picture exchange with the
relevant words. In addition, Tad—who had some word rep-
ciprocities prior to Pecs training—displayed the most vocal-
zations of the three children and also emitted other word
imitations (e.g., Talk 2) many times when he began to make a
word utterance during the picture exchange. Similar
results were found in previous research (e.g., Anderson
et al., 2007; Ganz et al., 2008; Ganz & Simpson, 2004), in
which children who exhibited echolalic speech prior to
Pecs training were more likely to demonstrate speech
improvement than those who did not vocalize prior to
Pecs training. It may be that the combination of the spoken
word and visual stimulus is more helpful in emitting word
vocalizations for children who already demonstrate an abil-
ity to vocalize (Carr & Peck, 2007). Nevertheless, it
should also be noted that it is possible that the increase in
word vocalizations would have reflected the maturation
effect, considering that the improvement was minimal and
the participants were very young.

The findings of this study provide promising implica-
tions for practitioners who work with young children with
ASD. Fundamentally, training parents to successfully
implement Pecs requires practitioners to develop and
maintain parent–professional partnerships. To do this, prac-
titioners should acknowledge the importance of shared
expertise and responsibility when working with parents.
In addition, at the practical level, practitioners should be
equipped with sufficient knowledge and skills for parent
training. That is, they need to learn diverse ways to teach
parents to conduct Pecs training. The best way to train
parents would be to provide one-on-one training sessions at
home, as the current study did. However, it may not be
cost-effective. As an alternative, it may be possible to com-
bine home training with group training. Another issue that
practitioners need to consider is how to maximize the effec-
tiveness of mother-implemented Pecs training. An Kuhn,
Leisman, and Vercrui (2003) described, if mothers can
Teach other family members Pecs in the same way they are
tought, multiple family members could learn how to use
Pecs with less time and effort, which may in turn produce
more benefits for children.

Although the findings of this study were positive, there
are a few limitations that should be addressed in future
research. First, the mother-implemented Pecs training did
not include all six phases of Pecs, but only Phases 1
through 3R. This was partly due to the restricted time frame
for the study. In addition, the primary interest of the authors
was to teach young children with ASD pure manual
responses that are under the sole control of the establishing
operation for each reinforcer, which can be taught during
Phases 1 through 3R. It may be tentative to conclude that
mothers can successfully teach Pecs to their child with ASD
and that mother-implemented Pecs training has positive influ-
ence on children's communicative behaviors. Therefore,
future research should extend mother-implemented Pecs
training beyond Phase 3R, which could make the findings
of this research more convincing.

Second, the current study used a changing criterion
design to demonstrate the effects of mother-implemented
Pecs training on children's independent picture exchanges
that were achieved in a stepwise manner. Typically, behav-
or changes in a changing criterion design should be dem-
Onstrated by the measures of the rate or frequency on a
single continuous variable. However, since the behavioral
objective of each phase of Pecs is not topographically
identical, the dependent variable of this study was com-
posed of an increasingly complex set of behaviors as the
phases progressed. Tats, as an alternate method, the criteria
were gradually increased until the terminal behavior was
achieved by adding one more step to the previous phase.
This made it possible to demonstrate experimental control
in this study that was conducted in each child's home. That
is, because the trainer and environmental factors varied
across participants, using a multiple baseline across partici-
pants design might not have established appropriate experi-
mental control. However, it may also have rendered the
experimental control of this study weaker. A possible way
to address this issue may be combining a changing criterion
design with a multiple baseline across participants in future
studies.

Third, the mother participants may not be representa-
tive of all mothers of young children with ASD, in that they all
volunteered for the study and had relatively high educa-
tional levels. Furthermore, this study trained only three
mothers. To be able to generalize these outcomes to a larger
population, future research should focus on mothers and
fathers and their children who have diverse characteristics.

Fourth, all the experimental sessions occurred at each
child's home, which made it difficult to control the training
environment as rigorously as in laboratory settings. For
instance, the frequency each mother used Pecs with her
child outside of the training sessions in daily routines was
not controlled in a same level across participants. Similarly, the children were receiving speech therapy, which varied in terms of the type and amount of time. Because of the social validity issue, it was impossible and inappropriate to restrict these therapeutic efforts. Future research should attempt to establish more control of possible extraneous variables, thereby increasing the internal validity of the findings.

Despite these limitations, the current study contributes to the literature as well as to devising effective ways to improve the communication skills of young children with ASD using PECS in several meaningful ways. The findings extend the existing evidence on PECS, demonstrating that the benefits of PECS can also be obtained by training mothers as primary implementers, which provides practitioners with insight into the feasibility and necessity of the parent-implemented PECS training. Moreover, the current study extends the existing evidence on PECS by working with very young children who were about 2.5 years old.

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