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Effectiveness of Combining Tangible Symbols with the Picture Exchange Communication System to Teach Requesting Skills to Children with Multiple Disabilities including Visual Impairment

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Abstract: The Picture Exchange Communication System (PECS) is an augmentative and alternative communication (AAC) program used to teach functional requesting and commenting skills to people with disabilities (Bondy & Frost, 1993; Frost & Bondy, 2002). In this study, tangible symbols were added to PECS in teaching requesting to four students (ages 7–14) with multiple disabilities that included a visual impairment. First, an assessment was conducted to determine the preferred (i.e., reinforcing) and non-preferred items for each participant. Then, a multiple probe design across participants was used to evaluate the effectiveness of the adapted training. Data were collected across baseline, training, and maintenance conditions, and generalization probes were conducted periodically throughout all conditions. All four participants learned requesting skills, generalized these skills to their classrooms, and maintained the skills after training. Recommendations are presented for future research regarding the use of adapted PECS with other AAC programs.

Communication is a crucial aspect of life. Through communication, people can request needs, share values and interests, and develop relationships with each other (Stoner et al., 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, many individuals with severe and multiple disabilities have communication limitations that make it difficult to understand others, request their needs, or respond to others' communications (Snell, Chen, & Hoover, 2006).

Research indicates that people with multiple and cognitive disabilities can benefit from intervention programs that increase communication and social skills (Beck, Stoner, & Bock, 2008; Schwartz, Garfinkle, Bauer, 1998; Snell et al., 2006). Individuals with severe disabilities can learn communication skills using AAC programs such as sign language, pointing to or touching pictures, or operating voice-output communication devices (Johnson, Reichle, & Evans, 2004; Snell et al.). PECS (Bondy & Frost, 1994) is one of the AAC programs that are used with children with autism and cognitive disabilities (Bondy & Frost, 1993; Frost & Bondy, 2002; Stoner et al., 2006).

The rationale behind PECS is based on teaching a systematic and functional way to communicate, as in other communication programs such as speech training and sign language for children who do not communicate clearly (Bondy & Frost, 2001). However, with speech training and sign language, children with autism and other disabilities typically do not learn to initiate communication with others. PECS was developed to teach spontaneous functional communication skills (Bondy & Frost, 1993).

PECS includes six phases through which a child is taught how to communicate, then to communicate with specific messages using single pictures, and then to communicate with multi-picture sentences (Frost & Bondy, 2002). It incorporates applied behavior analy-

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sis techniques that include reinforcement, fading through physical prompting, error correction, and generalization strategies.

PECS was originally created to provide a quick and functional communication system for children with autism and other social communicative disorders (Bondy, 2001; Bondy & Frost, 1993). Recently, researchers have used PECS to develop communication skills in individuals with cognitive and physical disabilities, visual impairment, or severe disabilities (e.g., Almeida, Piza, & Lamonica, 2005; Bock, Stoner, Beck, Hanley, & Prochnow, 2005; Ganz, Cook, Corbin-Newsome, Bourgeois, & Flores, 2005; Lund & Troha, 2008; Stoner et al., 2006). However, only one study (Lund & Troha) was conducted with students whose multiple disabilities included a visual impairment.

Lund and Troha (2008) adapted the standard PECS procedures for three students, ages 12 years and older, who had cognitive disabilities, autism, and blindness. Instead of using pictures, Lund and Troha used tangible symbols with three dimensions that could easily be used by the participants. One participant completed the communication program successfully, but the other two did not. Two important limitations were identified by the authors. First, they used only one preferred item for each participant during training instead of using various reinforcers. Second, they used one consistent verbal cue in all training; there was no attempt to entice participants with preferred items without the need for verbal cues.

The present study examined the effectiveness of combining tangible symbols and adapted strategies from PECS to teach requesting skills to pre-Braille level students with multiple disabilities that included a visual impairment. It was designed (a) to expand the use of PECS with these students and (b) to address the limitations noted in previous work.

Method

Setting and Participants

The study was conducted in a K-12 school that provided comprehensive educational services to children with visual impairment and multiple disabilities in the southwestern United States. School services included instruction in academics, daily life-skills, and community-based instruction (CBI) in which students learned and practiced real-life skills in the community. The school was the only one in the region that provided services to a wide range of students with visual impairment and multiple disabilities who also had communication development needs. Adapted PECS training was conducted in a separate room outside each participant's primary classroom. Generalization probes were conducted inside each participant's classroom.

Participants were four students, three girls and one boy, who were typically instructed in self-contained classes for students with visual impairment and multiple disabilities. The students' ages ranged from 7 to 14 years. Each participant also met the following criteria: (a) a diagnosis of multiple disabilities including visual impairment (per school records); (b) little or no verbal communication skills; (c) identified difficulties in overall communication skills (per teachers, parents, and school records); and (d) no prior PECS training.

Stephanie, age 8, was diagnosed with moderate cognitive disabilities, autism, and legal blindness. For desk work, she used some adaptive aids (a desk lamp and a slant board). According to her IEP, Stephanie could fixate on an object at 6 inches for 10 s, and shift her gaze from a 1-inch object to another at a distance of 3 inches. Her intentional communicative acts included a few one-to-three-word utterances and gestural communication such as pulling an adult's hand or reaching out her own hand. Stephanie sometimes required prompting to respond to questions. She often described what she was doing, rather than engage in communication with others around her. She had previously tried voice output devices but had limited success because she tended to perseverate on recorded sounds and voices.

Sameera, age 7, was diagnosed with moderate cognitive disabilities, cerebral palsy, and a visual impairment (bilateral optic atrophy, bilateral esotropia, and exotropia). She used highly contrasted, colorful materials for her school work. Sameera could label familiar objects and people from a viewing distance of approximately one-to-two feet. She used a

wheelchair and often reached for objects that came into her view. Though non-verbal, Sameera sometimes vocalized when attempting to communicate with others. To use tangible symbols effectively, she used a slant board with whole or partial objects.

John, age 14, was diagnosed with moderate cognitive disabilities, autism, a visual impairment (optic nerve-hypoplasia and nystagmus in both eyes) and an orthopedic impairment. He usually needed a physical cue to activate a voice output device at the appropriate moment in the classroom routine. At times, John responded verbally to a verbal request for a preferred item or activity. For example, when asked "Do you want to listen to the guitar?" he responded "Guitar." John spontaneously rejected items or activities by biting his knuckles and tensing his body. Given several repeated verbal requests, he sometimes said, "No thank you," but this was inconsistent.

Layan, age 13, was diagnosed with moderate cognitive disabilities, autism, and total blindness. She communicated using non-verbal behavior as well as approximations of one-word utterances such as "yes," "no," or "okay." For requesting, Layan typically depended on verbal prompts that presented choices. For example, she said "CD" when a teacher asked her "Do you want the tape or CD?" Layan had recently begun using a voice output device to indicate snack choices within the classroom. When presented a set of choices using tactile symbols, Layan was able to activate the device successfully with some physical prompting. For example, when a desired snack item was presented to her by placing it in her hand, she was prompted to touch the target symbol placed on the switch. Layan then successfully pressed the symbol to activate the device.

None of the participants was a Braille reader. Instead, they were learning to use tangible symbols or pictures paired with tangible symbols to obtain information about their environments. Therefore, the investigators, along with the school instructors, concluded that all four participants might benefit from learning PECS to attach meaning to the use of tangible symbols.

Staff

The staff included the principal PECS trainer (the first author) and two assistant PECS trainers. The principal PECS trainer, who had taught children with severe and multiple disabilities for three years, had received formal advanced training on PECS. He demonstrated the implementation of the first three phases of adapted PECS to the assistant PECS trainers. Training included hands-on, supervised practice with feedback until the trainers independently performed each PECS phase.

Materials

The materials included tangible symbols that were created for each participant by the PECS trainers. The tangible symbols were 3-dimensional, whole objects, partial objects, or samples of objects mounted on boards (Trief, 2007). The sizes of the symbols were determined by each participant's recognition skills. Velcro was glued on the back of each symbol so it could be attached to the each participant's binder (communication book). Velcro strips were also mounted on the outer cover of the binder as well as on each page of the communication book. Each participant had preferred items (e.g., food, toys, and/or activities) that were exchanged for tangible symbols.

Behavioral Definitions

A response was considered correct 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. A response was considered incorrect if the participant failed to perform any of these steps.

Research Design

A *multiple probe* design across subjects (Horner & Baer, 1978), a variation of a *multiple baseline* design, was used. In a multiple probe design, the researcher does not collect data continuously during baseline if it could cause strong negative reactions. Instead, the researcher periodically records baseline levels to ensure no

TABLE 1

Reinforcer Assessment Results

Participant	*Preferred Edible Items*	*Preferred Non-edible Items or Activities*	*Non-preferred Items or Symbols*
Stephanie	1. Grapes 2. Pizza 3. Pickles 4. Popcorn	1. Light box	1. Paper clips
Sameera	1. M & Ms 2. Mandarin 3. Chicken nuggets 4. Banana	1. Music switch 2. Clapping with other people	1. Blank symbol meaning "Nothing"
John	1. Juice 2. Ensure 3. Vanilla shake	1. Guitar 2. Piano 3. Spoon handle	1. Paper clips
Layan	1. Mashed potato 2. Hash 3. Spaghetti 4. Apple sauce	1. Jumping and dancing with a teacher.	1. Styrofoam

significant changes have occurred before introducing the intervention (Richards, Taylor, Ramasamy, & Richards, 1999). When there is a strong *a priori* assumption of stability because the participants have not been trained with the intervention prior to the study, periodic baseline recordings are considered a beneficial alternative to continuous baseline measurement (Horner & Baer).

After recording baseline data for each participant, the individualized interventions were introduced at different points in time, i.e., in Session 5 for Stephanie, in Session 17 for Sameera, in Session 23 for John, and in Session 31 for Layan. When each participant had met the criteria for all three phases of training, maintenance data were collected once or twice per week for the duration of the study. Generalization sessions were conducted in every training phase and in the maintenance phase.

Procedure

The study was conducted in four parts: (a) reinforcer assessment, (b) baseline, (c) training in the three PECS phases, and (d) maintenance.

Reinforcer assessment. To identify preferred and non-preferred items for each participant, the primary trainer followed the protocol described by Frost and Bondy (2002). This process included staff interviews followed by repeated presentations of potential preferred and non-preferred items until clear preferences were identified. The assessment process for each participant took a maximum of 2-½ hours and was conducted during regular school hours within one week. A total of 3-6 preferred items (including at least one edible and one non-edible item) and at least one non-preferred item were identified for each participant (see Table 1). (For a detailed description of the procedures, contact the first author.)

Baseline. During the baseline condition, the primary trainer worked individually with each participant. Because each had a visual impairment, the trainer used certain adaptations. First, instead of exchanging pictures for preferred items, participants were presented tangible symbols or pictures paired with tangible symbols throughout all phases. Second, instead of simply presenting preferred items, as is done typically in PECS trainings, a method of enticement was used. Because of the students' visual limitations, these methods included: (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 (Frost & Bondy, 2002), or (d) allowing the participant to smell the preferred items. The method of enticement used in each case was based on each participant's skill level. Third, tangible symbols normally placed on tables were placed on slant boards if it made it easier for the participant to respond. Fourth, to provide an auditory cue, the trainer moved the tangible symbol against the table or slant board.

To ensure that a preferred item was still reinforcing, the trainer gave a participant a free sample of the reinforcer used in the session, a method called *First One's Free* (Frost & Bondy, 2002). The trainer offered a bit of food or allowed the participant to hold or play with the item for few seconds. If the participant consumed or played with the item for few seconds, then it was presumed to still be reinforcing. If the participant did not reach toward the item or the tangible symbol, the item was considered not highly motivating, even after a free sample, and the trainer switched to another preferred item with a corresponding tangible symbol.

Each baseline session included 10 opportunities to respond. For each baseline trial, the trainer observed the first response within 20 s for three of the participants (Stephanie, John, and Layan). Because of Sameera's challenge with fine motor skills, she was given a 40-s response period. During baseline, no physical prompting or verbal guidance was permitted.

After each correct response, the trainer immediately gave the preferred item and verbally praised the participant. After each incorrect response, the trainer stopped the trial and then performed another trial until a total of 10 trials were presented. Some participants protested with loud vocalizations when the preferred item was not presented during a baseline trial. To decrease frustration, the trainer provided the participant a free sample of any preferred item *between* the trails, but not during the baseline trials.

Training. Training focused on the first three phases of PECS. In Phase 1, the goal was to teach the 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. The first, the *communicative partner*, sat or stood in front of the participant. The second, the *physical prompter*, was positioned beside or behind a participant to provide physical guidance, if needed (Frost & Bondy, 2002).

During Phase 1, the trainer often used the First One's Free strategy before training to ensure the item was still reinforcing. Next, the trainer placed the tangible symbol on the table or attached it to a slant board and then presented a preferred item using an appropriate enticement method. The assistant trainer provided physical guidance (a hand-over-hand technique) only when the participant reached for the preferred item. Guidance was provided for picking up the tangible symbol, reaching to the partner, and releasing the symbol into the partner's hand. When a participant felt the partner's hand, he or she typically released it. The partner immediately praised the student and provided the item (reinforcer) when he or she released it. While the participant was eating, drinking, or playing with a preferred item between trials, the two trainers got ready for the next trial.

The trainer repeated these steps throughout the session. Each session included at least 10 trials. When time allowed and students were interested, an additional 5-10 trials were conducted. This occurred during approximately 50% of the sessions with all 4 participants. However, the students' responses were recorded only on the first 10 trials.

The prompter faded physical prompts systematically by using a backward chaining technique (Frost & Bondy, 2002). The goal was to teach the participant to independently pick up the symbol, reach toward the communicative partner, and release the symbol into the partner's hand over successive trials and sessions.

If the student did not perform a particular trial as expected, the prompter used a *Backstep Strategy* for error correction (Frost & Bondy, 2002), i.e., took the participant back to the last step completed correctly and then provided physical assistance with the incorrect step in the sequence. When the participant responded correctly, the partner immediately praised and gave the item. If interfering behavior occurred, the Backstep Strategy was used for error correction. Training in Phase 1 continued for each participant until he or she

achieved a minimum percentage of 80% independent responding for at least two consecutive sessions.

In Phase 2, the goal was for each participant to make the same response learned in Phase 1, but the symbol was gradually placed further away from the participant (i.e., 2 or more feet away, compared to only 1 foot away). This distancing strategy was important so the participants would learn to keep communicating with others even when not within arm's reach. 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.

During Phase 2 training, one tangible symbol was attached to the cover page of the communication book. As with Phase 1, the partner first employed the First One's Free strategy to ensure the item was still reinforcing. While a participant sampled a preferred item, the partner put one tangible symbol on the cover page of the communication book and then used one of the enticement methods. With each trial, the partner moved back slightly from the participant by inches until he was 2 feet or more away. In this phase, the prompter provided physical assistance or guidance if needed and *only* after the participant reached for the tangible symbol and tried to remove it from the communication book. In subsequent trials, the communicative partner gradually increased the distance from the participant.

If a participant paused when reaching for the communicative partner, the prompter provided hand-over-hand guidance (Frost & Bondy, 2002). If the participant responded incorrectly in any way, the Backstep Strategy was used again. All other training, reinforcement, and prompting procedures were the same as in Phase 1. As with Phase 1, training continued until each participant reached at least 80% independent correct responses for at least two consecutive sessions.

In Phase 3, the goal was for the participant to choose the correct tangible symbol representing the preferred item from two tangible symbols (i.e., the highly preferred item and another symbol representing the non-preferred item). Only one trainer, the communicative partner, participated in Phase 3. Because the focus was 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 during the training sessions. As with the other phases, the partner first tested the highly preferred items by using the First One's Free strategy. To avoid memorization of the position of symbols on the communication book, the partner rearranged the symbols after the participant performed any trial correctly. The symbols were not rearranged during the error correction procedure.

As before, the participant and partner sat at a table, facing each other. The partner placed two symbols on the cover page of the communication book and presented two items to the participant, using an enticement method. The trainer also provided an opportunity for the participant to see, touch, or smell both items and both tangible symbols.

If the participant did not independently touch the symbols, the partner guided his or her hand to the symbols. The participant then was required to select the symbol for the preferred item. Correct responses immediately received praise and the item, as before. If the participant picked up the symbol for the non-preferred item, the trainer provided no verbal response and presented the non-preferred item to the participant.

At times, participants reacted negatively when given the non-preferred item by pushing it away or throwing it. When this occurred, the trainer performed an error correction procedure by putting the participant's hand on the correct symbol or tapping on the correct symbol, and then physically prompting the student to put the correct symbol into the partner's hand. When the participant gave the correct symbol to the trainer, he praised the participant but did not present the item. The trainer then attempted to distract the participant for 5 -10 s by turning the communication book over and then returning it back (per Frost & Bondy, 2002). This procedure typically resulted in the participant choosing the correct symbol independently. After performing the error correction procedure, the trainer again presented the preferred item. If a participant continued to make errors after three subsequent correction procedures, the trainer finished the lesson by returning to the mastery level training, as in Phase I.

Generalization sessions. Each generalization session was a single trial conducted in each participant's classroom. The purpose was to measure if the requesting skills generalized from the training setting to a natural setting, i.e., the participant's classroom. One tangible symbol was presented to the participant during Phases 1 and 2, and two tangible symbols were presented during Phase 3. The prompter was not involved. During generalization sessions, the partner offered no physical or verbal prompting to guide a participant to make a correct response. In addition, no error correction procedures were provided.

Maintenance. Maintenance sessions began when the participant met the criterion for Phase 3. During maintenance sessions, no training was provided. A trainer conducted 10 trials in the training room and one generalization trial inside the classroom. No error correction procedure or prompting was provided.

Data Collection

Two dependent variables were measured. The first, the percentage of correct responses, was measured during all baseline, training, and maintenance sessions. The percentage was calculated by dividing the number of correct responses by 10 trials, and then multiplying the result by 100%. The second dependent variable, a response of "yes" or "no," was measured during all generalization sessions. Each of these sessions included a single trial conducted in each participant's classroom. "Yes" was recorded if the participant responded correctly. "No" was recorded if the participant failed to perform any of these steps.

A primary observer recorded responses to the first 10 trials in each baseline, training, and maintenance condition, and in every generalization trial. To assess inter-observer agreement (IOA), a second observer independently recorded the same data during a minimum of 30% of the sessions in baseline, each training phase, maintenance, and generalization. An agreement was counted when both observers identically scored a participant's response, i.e., both scored "+" or "−" for the same trial (Umbreit, Ferro, Liaupsin, & Lane, 2007). IOA was calculated by dividing the number of agreements by the total number of agreements + disagreements, and multiplying the result by 100%. IOA averaged 100% for all baseline, training, maintenance, and generalization responses except Phase 2 training for Layan (97%) and Phase 3 training for Stephanie (85%).

Treatment Integrity

Treatment integrity was measured during 30% of all sessions. A checklist was constructed for each condition in the study. Treatment integrity was assessed by dividing the number of implemented steps by the total number of required steps, and then multiplying the result by 100%.

During baseline sessions, treatment integrity for all participants was 100%, indicating that no physical, verbal, or error correction was provided. Treatment integrity was 100% for all participants during Phase 1 training, and ranged from 97–100% during Phase 2 training and 93–100% during Phase 3 training. During maintenance conditions and all generalization sessions, treatment integrity was 100% for all participants, again indicating that no physical, verbal, or error correction was provided.

Results

Figure 1 shows the percentage of correct responses and "Yes" and "No" scores for all four participants. A functional relationship is apparent as the same basic pattern of responding can be seen with each. Stephanie made no correct responses during baseline. With training, her percentage of correct responses increased during Phase 1 (M = 85%), Phase 2 (M = 97%), and Phase 3 (M = 77%). During maintenance, she performed at 100%. Stephanie also responded correctly during all 13 generalization opportunities.

Sameera made no correct responses during baseline. With training, correct responding improved during Phase 1 (M = 63%), Phase 2 (M =100%), and Phase 3 (M = 90%). During maintenance conditions, she performed at 100% for four consecutive sessions. In addition, Sameera responded correctly on 7 of the 8 generalization opportunities.

John did not perform any correct responses during baseline. During Phase 1, his percent-

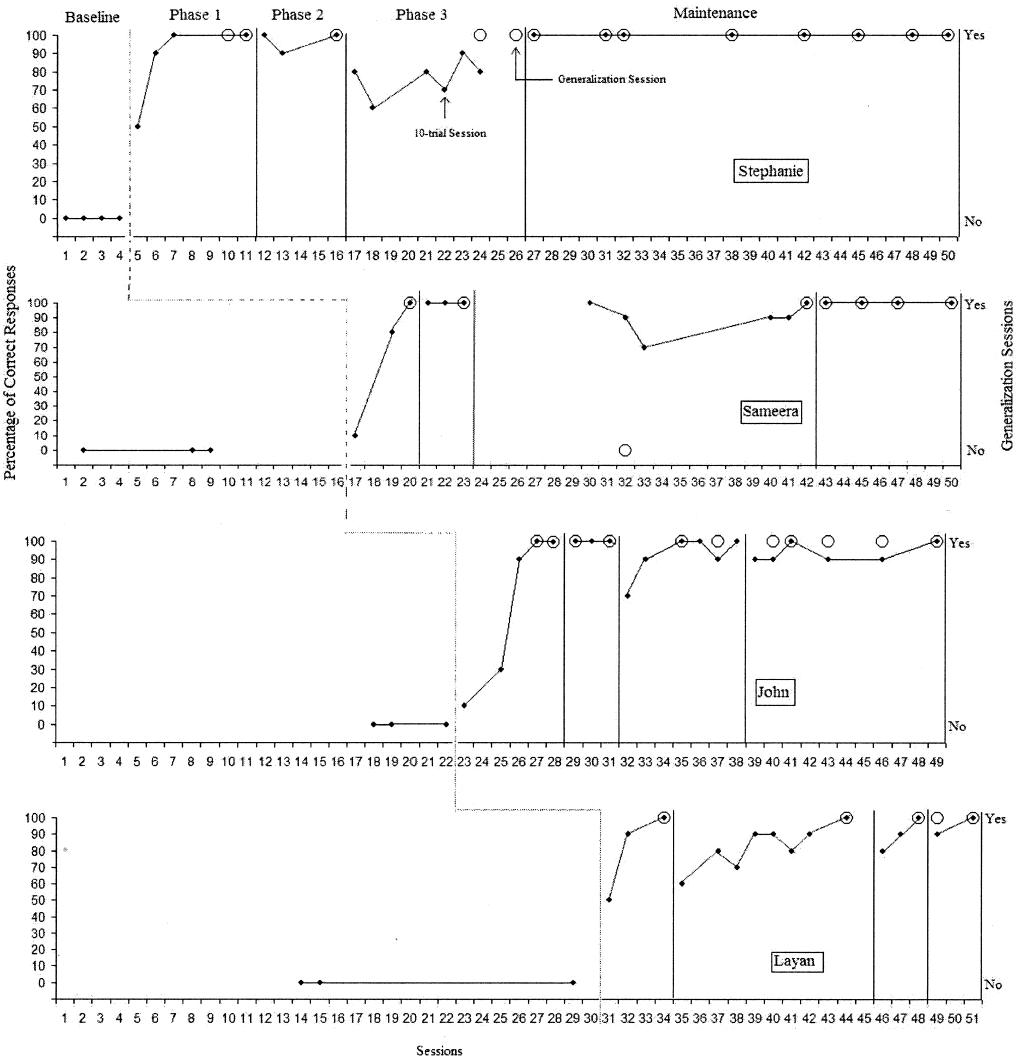

Figure 1. Percentage of correct responses and "Yes"/"No" scores.

age of correct responses increased ($M = 66\%$) and continued in Phase 2 ($M = 100\%$), Phase 3 ($M = 92\%$), and the maintenance condition ($M = 93\%$). John also responded correctly in all 11 generalization opportunities.

Layan made no correct responses during baseline. During training, the percentage correct increased in Phase 1 ($M = 80\%$), Phase 2 ($M = 82.5\%$), and Phase 3 ($M = 90\%$). During maintenance, she performed two sessions with an average of 95% correct responding. Layan also responded correctly in all five generalization opportunities.

Discussion

This study examined the efficacy of adapting PECS to teach requesting skills to pre-Braille level students with multiple disabilities that included a visual impairment. All four students learned to make requests for preferred items, maintained those skills after training ended, and generalized those skills from the training setting to a natural setting (i.e., their own classrooms).

This study's findings support previous literature that has reported positive results when

adapting PECS to teach requesting skills to students with multiple disabilities (Almeida et al., 2005; Ganz et al., 2005; Lund & Troha, 2008; Malandraki & Okalidou, 2007). It also expands this literature by providing additional data on an adaptation of PECS that can be used to teach students with multiple disabilities and visual impairment. The study specifically addressed some of the limitations Lund and Troha (2008) identified in their own work. These investigators used a single preferred item with a corresponding symbol and provided verbal cues to elicit responses. In contrast, the present study employed at least two preferred items with two symbols for each participant and individualized methods of enticement to avoid using verbal prompting. The data suggest that these adaptations enhanced the effectiveness of PECS in teaching requesting skills to these students.

Phase 3 training was very challenging for three of the four participants (Stephanie, Sameera, and John). In this phase, the participant had to hand a tangible symbol to the partner after first choosing the correct tangible symbol. The differences between the two tangible symbols appeared to be a critical variable. When the two symbols were clearly differentiated by shape, color, and/or size, the tasks appeared easier for the participants to learn. When the two symbols were more similar, the tasks appeared more difficult to master.

In comparison, Phase 2 was the most challenging phase for Layan, the only participant with complete visual loss. In this phase, the distance was increased from 1 to 2 feet. Layan required more training sessions than the other participants in this phase. She 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 for a student without any vision.

Because the intervention was applied over time in a single-subject design, documentation of implementation fidelity is required and highly desirable (Horner et al., 2005). Treatment integrity was measured for approximately 30% of the sessions in each condition. Results indicated high levels of treatment integrity, providing evidence that the training was conducted with high fidelity.

Certain limitations should be noted. First, students in this study were taught to exchange a tangible item in response to a prompt in which they were first offered something. In this respect, they were not purely initiating the request. Although this format is consistent with the model underlying PECS, more research will be needed to establish the methods that might lead to independent initiations by users in both structured and natural contexts.

Second, because of the heterogeneity of the population under study, it is reasonable to assume that the participants may have been functionally similar in some ways and functionally different in other ways. This fact could challenge the basic assumptions of the multiple probe design that was used. However, this concern is minimized by the consistent pattern of responding by each participant across the various phases of the study.

Third, the study was conducted under controlled conditions that may not approximate prevailing conditions in some classroom environments. Sessions were conducted in a separate room, away from typical classroom activities, and none of the students regularly participated in inclusive classrooms with typically functioning peers. More research is needed to understand the methods that will be most effective in such environments and to better understand how naturally available opportunities to develop and support communication might facilitate the process.

Fourth, although the findings provide evidence that the participants generalized requesting skills to their classrooms, there was no evidence of generalization of the acquired skills to other environments such as the cafeteria, playground, or participants' homes. The effectiveness of adapting PECS to teach requesting skills to other similar participants in other environments warrants further research.

Fifth, maintenance data showed that participants maintained their requesting skills at a high level for one-to-four weeks after training ended. Continued assessment of the effectiveness of PECS over months and years remains a question for further research.

Because PECS is considered an AAC system used in various environments and at different times (Frost & Bondy, 2002), service providers

need to work collaboratively to incorporate PECS in typical routines and provide students opportunities to use PECS to communicate with others. When teaching PECS with adaptations to people with multiple disabilities including visual impairment, the long-term goal should be communication with PECS in natural settings, e.g., inclusive classrooms, playgrounds, cafeterias, homes, and other community sites.

The PECS system was developed primarily to teach spontaneous and functional communication in natural settings with an emphasis on requesting and commenting skills (Frost & Bondy, 2002; Ostryn, Wolfe, & Rusch, 2008). In this study, the participants learned requesting skills, but not other communication skills such as questioning, conversational vocabulary, and joint attention. Any communication system developed for students with disabilities needs to be based upon their individual abilities, learning contexts, and experiences, and adapted to meet their communicative needs. In this effort, PECS should be incorporated with other communication systems in order to achieve the most effective communicative functions for people with disabilities in varied situations.

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