Adapting the Picture Exchange Communication System for a Student with Visual Impairment and Autism: A Case Study

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Abstract

In this case study, a student with visual impairment and autism successfully used an adapted form of the Picture Exchange Communication System to communicate with multiple partners in her educational setting. A changing-criterion design measured the child's progress in learning 24 different object symbols within 21 intervention sessions. The student's learning rate, acquisition of symbols, and learning of sentence construction offers a teaching strategy for educators as well as suggestions for future researchers.

Keywords: autism, Leber's, communication, augmentative or alternative communication, adapted PECS

Practitioners in the field of visual impairments have been challenged to create effective strategies for students with severe visual impairments and autism (Gense & Gense, 2005). The prevalence of autism spectrum disorders (ASD) may be higher in persons with visual impairment (11.6 percent) compared with the general population (0.6 percent) (Centers for Disease Control and Prevention, 2007). Recent studies also suggest that the risk of autism increases with the severity of visual impairments (Mukaddes, Kilincaslan, Kucucyazici, Sevketoglu, & Truncer, 2007).

Communication deficits have been identified as a hallmark problem for both students with ASD (Odom, Brown, Frey, Karasu, Smith-Canter, & Strain, 2003) and students with visual impairments who have additional disabilities (Rowland & Schweigert, 2000).

Communication interventions with students who have autism rely heavily upon visual input through pictures for teaching strategies such as modeling and prompting, as well as communication (Odom et al., 2003). Adapting strategies that have established evidence from the field of autism and have embedded knowledge from the field of visual impairments may be supportive of student progress.

Originally developed by Andrew Bondy and Lori Frost in 1985, the Picture Exchange Communication System (PECS) was used primarily with young children with ASD who had limited or no functional speech (Frost & Bondy, 2002). Blending applied behavioral analysis principles with communication principles (such as learning to intentionally send a message to a listener), PECS was designed to support the development of functional communication (Frost & Bondy). PECS, due to both its visual communication and its basis in behavioral principles, particularly identifying potential reinforcers, has been characterized as a strategy that lends itself to meeting the communication needs of some students with ASD (see Tien, 2008). There are six phases in the PECS teaching protocol: how to communicate; distance and

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 | Received September 14, 2009; Accepted November 10, 2009

persistence; picture discrimination; sentence structure; responding to questions; and commenting (Frost & Bondy). Within each phase there are subcomponents for teaching students to engage in exchanges with a communication partner for items or activities that the student desires (Frost & Bondy). Unlike some other augmentative or alternative communication approaches (e.g., teaching labeling using sign language), PECS was designed to teach students to initiate communication, based upon the most reinforcing items for the individual.

Researchers in several studies have demonstrated the efficacy of teaching PECS to children who have ASD as well as to children and adults with developmental disabilities (see Tien, 2008, for review). Due to the pattern of replication from several experimental studies, PECS is considered to have an established base for building the functional communication skills of some nonverbal students with ASD (Tien, 2008). For students with visual impairments—either with autism or intellectual disabilities—there is a lack of research demonstrating how PECS, when adapted to compensate for severe vision loss, may be useful for building functional communication. Although some studies have evaluated the use of three-dimensional (3D) object symbols for developing communication for individuals with visual impairments (e.g., Rowland & Schweigert, 2000; Trief, 2007; Turnell & Carter, 1994), few have been designed around the PECS protocol, which teaches initiation using the most reinforcing items for each participant. An extensive search produced two studies that were based on the PECS intervention for students with significant visual impairments (Finkel, Weber, & Derby, 2004; Lund & Troha, 2008).

In a study with a 24-year-old participant who was congenitally blind and had developmental delays, Finkel and colleagues (2004) developed braille cards to use in communication exchanges. These authors reported that the participant was already able to use uncontracted braille before beginning the study and that the goal was to improve her articulation, making her requests more recognizable to communication partners. Finkel and collaborators referred to the intervention as the Braille Exchange Communication System (BECS). The PECS intervention framework was not followed closely nor was the use of pictures or referent objects included in the study. It is not clear from Finkel's report that the development of the braille cards was based upon an assessment of the participant's interests and preferences, which is a departure from the PECS program.

Recently, Lund and Troha (2008) conducted a multiple-baseline design study that included three students with autism and congenital blindness in which 3D object symbols (parts of items based on student preferences) were developed as PECS material. In the study, the investigators drew from Rowland and Schweigert (2000) as well as Turnell and Carter (1994) to create the object symbols and implement their use within PECS phases. Of three participants, only one reached Phase III of the PECS intervention (discrimination between two symbols). Lund and Troha's study indicated the participants acquired very few object symbols. Although this research provides evidence of efficacy in using 3D objects within the process, it also encourages replication as well as examination of more advanced symbol arrays and complex requesting behaviors.

In order to further substantiate the use of adapted PECS for students with combined autism and visual impairment, additional examination is required, exploring both the materials used to shape successful communication and protocol adaptations to encourage students to advance to more complex communication. At this point, an adapted approach using 3D object symbols, though successful, has shown modest results in terms of the numbers of items a child with visual impairment and autism may request. It also does not demonstrate that children with concomitant autism and blindness may advance to more complex forms of requesting, such as creating sentences. The current case study examines a 7-year-old's response to adapted PECS for teaching a variety of symbols, as well as for shaping more complex communication behaviors with multiple partners at school. The following question was answered in this study:

> Can an adapted version of the PECS intervention be successfully implemented with a student who has severe visual impairments and autism to enhance the array of symbols that a child may request, as well as more complex discrimination among symbols?

Method

Participant

"Molly" is a 7-year-old girl identified as having Leber's congenital amaurosis, nystagmus, and

classic autism. Her ophthalmological reports offer little information as to her visual acuity, stating that she is legally blind and that her uncooperative behaviors prevented in-depth testing. Molly's functional vision evaluation did not indicate that she responded to color but described her as preferring to stare at lights and orienting her face toward the sun when playing outside. Data from her learning media assessment (LMA) (Koenig & Holbrook, 1995) did show that she had the ability to discriminate among textures and that her preferred learning modality was tactile. Her orientation and mobility (O&M) assessment, conducted by a certified orientation and mobility specialist (COMS), described her as having limited awareness/anticipation of drop-offs or changes in terrain. The O&M report described her strength in localizing toward environmental sounds and her ability to use landmarks; however, she did not travel independently outside of the classroom. She had no indication of hearing loss. When she was 6 years old, Molly was tested using the Gilliam Autism Rating Scale (Gilliam, 1995), the Childhood Autism Rating Scale (Schopler, Reichler, & Remler, 1986), and the Autism Behavior Checklist (Krug, Arick, & Almond, 1993) and was found to be in the severe range for autism. Although formal intelligence testing was not administered, it was suggested in clinical reports that Molly has an intellectual disability. Molly was known to have aggressive and self-abusive behaviors (e.g., biting, punching her head). Her noncompliant/disruptive behaviors included dropping to the floor when being guided to a new location, hiding under her desk, chewing objects, and wailing. Molly was not toilet trained at the time of this study. Molly's communication age equivalence, as measured using the Communication Matrix (Rowland, 2004), was shown to be about 12 months of age; she used unconventional expressive forms such as vocalization as well as rocking back and forth on a swing to indicate "more."

Setting

The study was conducted in a self-contained classroom within a rural elementary school. Molly was one of six students in a class taught by a certified special education teacher and supported by two full-time paraprofessionals. Molly was seen on a weekly basis by a variety of service providers, including a certified teacher of the visually impaired, COMS, speech and language pathologist (SLP), occupational therapist (OT), and an adaptive physical education teacher. Molly traveled outside of the classroom for speech, mobility, physical education, and OT instruction.

Assessment and Materials Development

A person-centered planning approach with her family and service providers was used to learn what types of activities, foods, materials, and objects were motivating for Molly (O'Brien & Lyle-O'Brien, 2002). A reinforcement assessment also was conducted to determine the edible/nonedible items Molly enjoyed. This included a videotaped, forced-choice, item-by-item assessment of edible and nonedible reinforcers (Mithaug & Hanawalt, 1978). A combination of familiar and novel items/foods was used; the assessment was conducted over 4 days. Two items were presented to Molly simultaneously by having each choice touch her elbows or arms. Molly was given a 15-second interval to respond to either item. The object or food she selected as "preferred" (deemed by her holding the item, smiling while playing with the item, manipulating the object, or smelling or tasting the food) was used in the next trial to compare with a new object or food option. Out of the assessment, Molly preferred a shape sorter, a mouse pad, a light-up molecule ball, a music keyboard, a duck toy, and several other items. Using person-centered planning, as well as observation of Molly in her routines, it was determined that she also responded positively to rocking on a large plastic frog on the playground; jumping on a mini trampoline; swinging on a therapy swing; playing in water at the sink; listening to music; hiding in a large cardboard box; and riding on a tricycle on an outdoor track.

Object symbols were created using parts of actual objects that were glued to laminate squares and were based on Molly's most preferred items. Uncontracted braille labels were placed at the bottom of each object symbol (with labels in print on the back for the communication partners) in order to expose her to word labels during communication sessions. Sample representation of referents included a 2 $\times$ 2-inch piece of a mouse pad glued to the square, representing the pad; the lid to a small Play-Doh container to represent Play-Doh; a metal spring identical to the mini-trampoline springs attached to the laminate square to represent the mini trampoline; a large metal clasp that was identical to the swing to request swinging; and real Goldfish crackers sealed in glue on the laminate to represent Goldfish. It is important to note that items selected were ones that Molly had interacted with

tactually. For example, the clasp used to represent a swing was the exact shape, weight, and size of the metal clasp that she had handled numerous times with the OT to attach her therapy swing to the swing stand.

Dependent Variables

The percentage of unprompted communication exchanges out of the total number of exchanges was measured for each session. Molly only got credit for an unprompted exchange if she required no form of touch prompts to complete the exchange. Additional sound cues were made for Molly due to her visual impairment.

Design

This study used a changing-criterion design (Osborne & Himadi, 1990) across the successive PECS phases. When Molly reached a criterion of 80 percent or better of unprompted exchanges per session within a phase, she was introduced to the next PECS phase.

Procedure

All baseline and intervention sessions were coded using PECS data forms (Frost & Bondy, 2002). All sessions were conducted by the first author within Molly's school routine, embedding communication opportunities within her regular schedule (such as teaching adapted PECS with edibles during snack time or offering outdoor activity symbols during recess). More than 60 percent of the sessions were videotaped. There were 21 sessions, and Molly had an average of 31 exchange opportunities for each session. Sessions lasted from 30 to 40 minutes each and occurred over 10 weeks within the semester.

Baseline

Three days of baseline data were drawn examining Molly's unprompted communication exchanges within her daily routines, interacting with known objects and with familiar partners. In addition to not using objects to communicate, Molly made no verbal requests. Any of Molly's word approximations were the result of extensive verbal prompting on the part of staff.

PECS Phases and Adaptations Made Based upon Visual Impairments

Phase I of PECS included symbol exchange to teach her to request one item (only one presented). A second communication partner was engaged to shape Molly's response, so that when she reached to grasp the preferred item, she was guided physically from behind to pick up the object symbol and hand it to the first communication partner, who held the preferred item. Physical prompts were faded until the exchange was independent. In the traditional PECS protocol, the communication partner is to silently "tempt" the student to reach for the item. When the child reaches for the preferred object or food, a second partner physically guides the student to reach for the picture to hand to the person holding the desired item to complete the exchange. In Molly's case, we adapted the protocol to maximize her other senses as well as her residual vision. Molly was seated in a position where she typically worked with staff. The first partner enticed her by using auditory cues or exaggerated visual cues, such as moving the item vigorously. For food items, olfactory and auditory cues were used, such as purposefully rattling the wrapper or shaking the bag of the preferred foods. Just as with traditional PECS, a second partner shaped her initial exchanging behavior, fading the level of prompting as she learned to independently exchange symbols.

Phase II of the PECS intervention included having Molly travel to her communication partner in the room to make the exchange using one symbol. In traditional PECS, the partner gradually distances herself from the student and concomitantly increases the space between the communication book and the student, encouraging the student to travel to the book and then to the partner to make the request. In PECS, there is an emphasis on not enticing verbally. For Molly, this was adapted both in offering her speech cues, such as "I am going to your desk with the mouse pad," as well as in giving exaggerated sound cues, such as pushing the chair loudly or walking loudly to cue movement away from her. She was never required to search for her book, because it was always kept in front of her. At the onset of Phase II, Molly needed a second partner to prompt her to stand up to move toward the communication partner; however, Molly quickly began to independently locate her partner within her classroom setting using the sound cues in combination with her residual vision. During the day, her communication book and object symbols were always kept in the same location so she could retrieve them easily.

Phase III included discrimination among referents, starting with highly preferred and nonpreferred,

gradually increasing the array of symbol choices to six. In typical PECS, the student's choosing behavior is taught by using highly preferred items in contrast to neutral or disliked objects. It is based upon a person's visual discrimination between pictures and shaping responses. For Molly, we adapted this phase by tactually introducing her to the object symbols and offering her the items' names as she touched the cues and braille labels prior to initiating her request. We also enticed her with exaggerated auditory cues when we had the items in our hands. When she chose the wrong cue, the communication partner modeled the correct item using hand-under-hand support within the four-step error-correction protocol recommended in PECS.

"Correspondence checks"—recommended in Phase III for assessing whether the student knows what she has requested—were adapted so that objects were in close range and incorporated high contrast so that Molly could use her residual vision. For example, when Molly requested Goldfish crackers during snack time, a correspondence check involved making sure the yellow Goldfish was on a dark piece of construction paper next to the nonrequested item and within 1 foot of her body, so she could choose what she requested.

Phase IV included sentence construction, teaching her to place the "I want" card in large raised print and braille on a sentence strip in front of the desired object symbol and make the exchange. The only adaptation that was made for her was the use of "I want" in 48-point black, bold font on a white background with added black puff paint enhancing the letters on the laminate square and braille for this portion of sentence building. The traditional PECS protocol for teaching the use of the sentence starter was strictly followed, with it being placed initially by the communication partner on the sentence strip before Molly selected her preferred cue. Molly was taught to move both the sentence starter and referent for her desired item down to the sentence strip and hand it to her partner. Enticement using exaggerated auditory, visual, and olfactory cues provided Molly with the access for making requests.

Interobserver Agreement and Procedural Integrity

Interobserver agreement on Molly's performance was determined by measuring her percentage of unprompted (independent) exchanges for each session. Two raters judged 30 percent of total sessions by reviewing video data and using PECS coding forms. Typically within single-subject design studies, determination of interrater reliability is based upon one third of the observed intervention sessions (Kennedy, 2005). Interobserver agreement was calculated by dividing the number of agreements by the number of disagreements and multiplying by 100. Interobserver agreement for this study was 100 percent. Fidelity of implementation was based upon an independent coding process, by reviewing video footage of sessions using a specific protocol that outlined each procedural step the communication partner was to follow for each exchange. This was based upon PECS procedures with adaptations made for Molly based upon her visual impairments (see description of PECS phases and adaptations). Fidelity of implementation was calculated for 30 percent of the total sessions to be 94 percent.

Doctoral students in special education who had attended a 2-day PECS workshop determined both fidelity of implementation and interrater reliability. Each determined coding procedures based upon PECS protocol and forms. Once procedures were clearly defined, raters viewed videotaped sessions independently to code the child's responses (reliability) as well as the researcher's adherence to the PECS intervention protocol.

Results

Molly had zero percent of unprompted exchanges among three 10-minute videotaped samples in her baseline phase. In Phase I, Molly reached criterion within three sessions, starting from 56 percent unprompted in her first session and attaining 87 percent unprompted exchanges in her third session. In Phase II, Molly attained criteria during her first day of implementation (86 percent unprompted exchanges) and achieved 100 percent unprompted exchanges during her second session. In Phase III, it took Molly three sessions to discriminate between two symbols at criterion. She then systematically progressed to discriminating successfully among three, four, five, and six symbols in her communication book. In Phase IV, Molly achieved criterion during her second session (96 percent unprompted exchanges) and continued at high levels of performance in subsequent sessions (see Figure 1 for visual analysis).

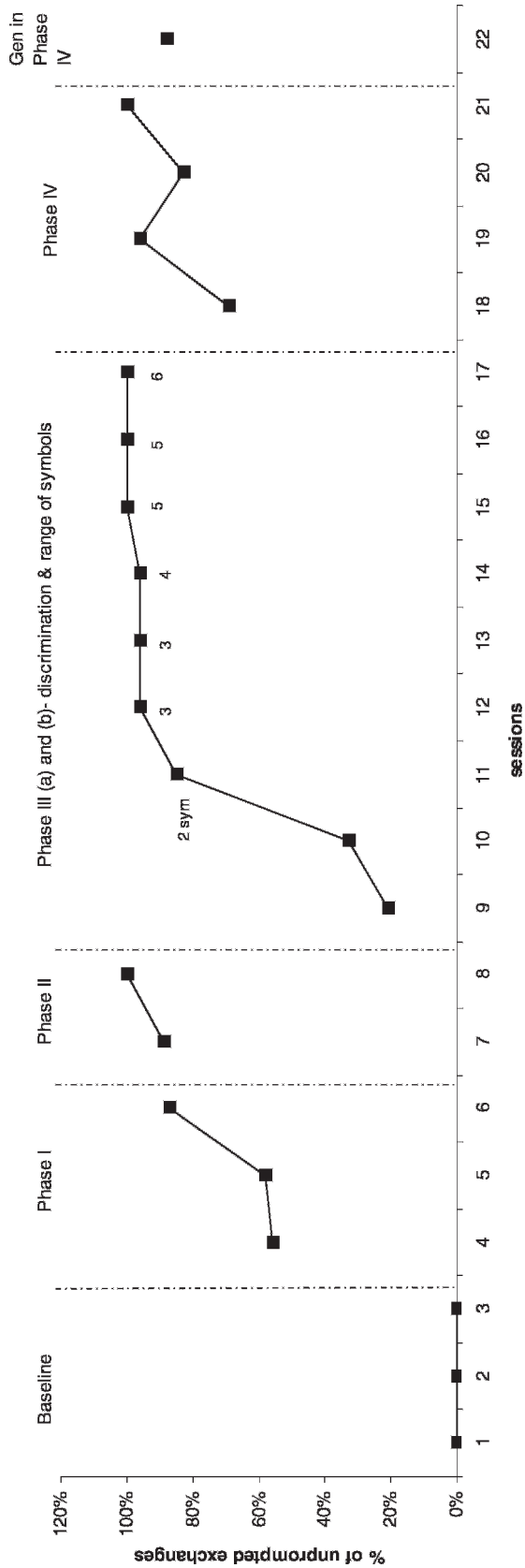

Fig. 1. *Results of adapted Picture Exchange Communication System with Molly.*

Array of Symbols and Communication Partners

Molly acquired 24 object symbols within the adapted protocol. Nonedible symbols included trampoline, swing, tricycle, rocking frog, shapes, mat, music CD, duck toy, toothbrush, Play-Doh, mouse pad, Lego, ball, molecule ball, keyboard, bell, and box. Referents for edibles included cotton candy, Goldfish crackers, Oreos, water, milk, Nerds candy, and gum. Data were collected on her use of the symbols in these locations (see Table 1): in playground, self-contained class, OT room, and in a community setting (retail shop). Molly was able to use these symbols consistently with six partners: her paraprofessional, teacher, OT, SLP, and two members of the research team. On one occasion Molly was encouraged to use PECS with her peers on the playground.

Molly's team was primarily trained to support the use of adapted PECS through observation of the intervention sessions and review of video data with the researchers. Molly's paraeducator had attended a formal PECS workshop and was well aware of the PECS protocol. All intervention sessions were conducted with members of Molly's team present.

Generalization

One generalization measure in a community retail shop showed Molly's performance at criterion. Within this context, Molly had access to her communication book and could make requests for snacks that were offered in a section of the store.

Social Validity

In response to treatment acceptability questions (Tarnowski & Simonian, 1992) that were rated on a 5-point Likert scale, Molly's paraprofessional and teacher individually answered "strongly agree" to all the efficacy and acceptability questions. Additional comments from the respondents included "This has worked wonders for our student"; and "Immediately Molly's expressive communication improved (when using the symbols). We have had a little trouble getting her to use verbal approximations to words; she has been primarily giving random grunts (especially to me) instead of word approximations."

Discussion

Molly's success offers an example of the power of adapted PECS, for students as well as for her communication partners. There is a promising trend in this particular child's progress to Phase IV in PECS and in the number of symbols she acquired. Molly's acquisition of PECS is believed to be based upon several factors, including the readiness and support of her educational team to begin this intervention; embedding adapted PECS training within her school routines; Molly's proclivity for tactile discrimination as indicated in her LMA; using formal and informal reinforcement evaluation to outline the array of Molly's preferences; and adapting the PECS protocol, using parts of objects, sounds, smells, and exaggerated visual cues, to compensate for Molly's visual impairment.

Molly successfully used adapted PECS with several communication partners in her classroom, which was not reported in some other PECS (e.g., Lund & Troha, 2008) or object symbol (e.g., Rowland & Schweigert, 2000) studies. Molly rapidly acquired the use of PECS through Phase IV, independently constructing sentence strips to make requests in 21 formal teaching sessions with an average of 31 trials per session. Her acquisition rate exceeds previous studies with sighted children with multiple disabilities (Schwartz, Garfinkle, & Bauer, 1998). Additionally, Molly learned the use of 24 distinct symbols (including edibles and nonedibles). It is important to note that her performance exceeds the progress made by students in previous studies such as Lund and Troha's (2008), which reported the use of only one preferred symbol for requesting. Molly may have been able to acquire more symbols because the team knew what items were the most reinforcing to tempt her to request a larger variety of things, given that an extensive informal and formal reinforcement assessment was used. Additionally, her LMA clearly showed Molly's strength in tactile discrimination over auditory or residual visual information.

Implications for Practitioners and Families

It is time-intensive to create durable object symbols for communication. Materials that were selected for Molly, laminate squares with items attached using Gorilla Glue, were based upon her predilection for chewing objects. Through systematic assessment, it was determined which objects would be most motivating to her. In accordance with traditional PECS, nonpreferred and neutral items also were created to provide her with opportunities for discriminating

Table 1. Adapted Picture Exchange Communication System (PECS) Symbols Used by Molly

Desired Item	Adapted PECS Symbol	Setting	Desired Edible	Adapted PECS Symbol	Setting
Mouse pad	2 × 2-inch mouse pad glued on laminate	Classroom/ SLP[a]	Water	Water bottle cap glued onto laminate	Classroom, community retail shop
Mat (bumpy shelf liner)	2 × 2-inch shelf liner glued on laminate	Classroom/ SLP	Milk	Milk carton top glued to laminate	Classroom
Music	Half a music CD glued on laminate	Classroom/ SLP	Goldfish crackers	Two Goldfish crackers sealed in Gorilla Glue on laminate	Classroom
Keyboard	Microphone piece to keyboard glued on laminate	Classroom/ SLP	Oreos	Oreo wrapper and miniature Oreos sealed in glue on laminate	Classroom, community retail shop
Rubber ball	Identical ball on laminate	Classroom	Gum	Square piece of gum glued on laminate	Classroom
Trampoline	Trampoline spring glued on laminate	Classroom/ OT	Nerds candy	Nerds candy box glued on laminate	Classroom, community retail shop
Duck toy	Fabric of duck toy on laminate	Classroom	Cotton candy	Lid of cotton candy container glued on laminate	Classroom
Lego	Lego glued on laminate	Classroom/ OT			
Molecule ball	Ball covered in plastic glued on laminate	Classroom/ OT			
Play-Doh	Play-Doh lid glued on laminate	Classroom/ OT			
Christmas bells	One bell glued on laminate	Classroom			
Large refrigerator box for playing in	2 × 2-inch cardboard box glued on laminate	Classroom			
Shape sorter toy	One shape from the set glued on laminate	Classroom			
Rocking frog	Identical handle from frog toy glued on laminate	Playground			
Tricycle	Identical tricycle pedal glued on laminate	Playground			
Therapy swing	Identical swing clasp	OT			

[a] *SLP = speech language pathologist; OT = occupational therapist.*

meaningfully when she was working on Phase III. Because these symbols were parts of objects glued on laminate squares, they were particularly large. They were stored within the classroom inside plastic drawers. The communication book with the most frequently chosen symbols was placed near the drawers of referent symbols. Heavy-duty Velcro was used to attach the symbols to the book. Molly was made aware of the area where her symbols and book were kept, so she could travel easily to this area to retrieve what she desired beyond her PECS training sessions.

Implications for Future Research

Most PECS research typically has been conducted with sighted children (Tien, 2008). Molly's case study offers a basis for exploring modifications that are specific to nonverbal children with visual impairments as well as offering some foundation for basic O&M intervention by promoting initiation and travel to a communication partner.

This study incorporates uncontracted braille for exposure to corresponding words with objects. This area needs more exploration to develop studies that might link this type of communication training with more formal literacy development. The student was encouraged to explore both the object symbol and the braille label as she was making requests; however, the intervention emphasized communication rather than reading behaviors. Formal testing and incorporation of braille instruction with object symbols could complement or advance a student's progress using a communication system.

In Phase IV, Molly was able to discriminate the sentence starter "I want," which was in 48-point, high-contrast print with black puff paint and an uncontracted braille label, from her object symbols. It is not known if Molly was beginning to recognize the words "I want" other than being able to tactually discriminate this cue from the other object symbols. It is significant that Molly verbally demonstrated the use of "I want" in combination with words. Both her mother and teachers reported that this was the first use of unprompted multiword phrases that were non-echolalic.

Limitations

Limited conclusions may be drawn from this study due to its lack of experimental control across participants or settings; however, data indicate that this intervention had practical and social value for the participant in her school setting. The study was limited by the school term and by unforeseen circumstances with Molly's family that prohibited some data collection in her home setting. It is important to note that Molly's mother was involved in initial person-centered planning, review of video progress throughout the intervention, and in having the team visit Molly's home to collect baseline data. The original study design involved a second phase of implementation within Molly's home, but this was prevented due to extenuating life events for Molly's family.

Conclusions

This study's outcomes, conjoined with evidence from Lund and Troha's study (2008), offer suggestions to practitioners on how PECS may be adapted for individuals with severe visual impairments and autism. In order to meet the demands for research-based practices for students with disabilities, more replications for students with visual impairment and autism across settings and age groups are needed. More important, finding effective teaching strategies for this population is critical for giving students a vehicle for making progress in communication and language and for sharing their voices with their families and educators.

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