Teaching Adults with Intellectual Disabilities to use the Picture Exchange Communication System

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Abstract

The Picture Exchange Communication System (PECS) is an alternative augmentative communication system that uses a variety of behavioural techniques to teach nonspeaking individuals functional communication skills. Ten empirical evaluations of PECS have been reported in the literature since it was developed, many of which have considerable weaknesses such as lack of a baseline assessment of using PECS, lack of relevant discrimination skills of the participants, and a lack of treatment integrity measures. The purpose of this study was to provide further empirical data regarding the efficacy of PECS with adults with severe intellectual disabilities. During initial baseline assessments of three participants, all three demonstrated some of the skills required for PECS (e.g., removing a picture from a binder and giving it to the experimenter). However, none of the participants were able to reliably select the food item that corresponded to the picture they had selected. Therefore, training for this skill was provided in a modified multiple-baseline design across participants. Participants 1 and 2 met mastery criterion after considerable training using individualized fading programs. Participant 3 showed an overall improvement across baseline assessments and therefore training was not implemented. Correspondence between picture and subsequent item selection is an important component of PECS and results of this study suggest that this skill may require extensive training for some persons with severe intellectual disabilities. Baseline discrimination skills that could significantly impact learning efficiency and future research are discussed.

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Introduction

Alternative and augmentative communication (AAC) techniques are often provided to individuals with intellectual disabilities who are unable to communicate functionally through spoken language (Zangari, Lloyd, & Vicker, 1994). Common AAC systems include voice output communication aids (VOCAs), picture books, and touch or point systems. Nonspeaking individuals can use AAC systems to respond to others and/or to initiate a social exchange such as to request items or activities.

In traditional AAC systems involving pictures, the person is taught to point to or touch a picture in order to communicate (Millar, Light, & Schlosser, 2006). Picture-pointing systems often begin by teaching labeling as the first communicative behaviour, which is maintained by educational or social reinforcers (Skinner, 1957). This may not be the best strategy for teaching the individuals who will be using these systems. Children with autism, for example, are more motivated by tangible outcomes than they are by social rewards (Mundy, Sigman, & Kasari, 1990).

Bondy and Frost (2001) have identified other problems with traditional picture-pointing systems. First, many individuals, because of various physical limitations, are inaccurate pointers or have difficulty isolating a single finger to point. Second, the individual can come to rely on verbal prompts to respond. That is, individuals may wait for someone to approach them, often with a question such as “What do you want?” before attempting to use the pictures. Finally, learning to picture-point does not ensure that someone will always be there to respond when it does occur. A person can be near the

individual but not see the attempt to use the picture, so that the pointing behaviour may be extinguished.

The Picture Exchange Communication System

The Picture Exchange Communication System (PECS) is an AAC system that uses a variety of behavioural techniques to teach nonspeaking individuals functional communication skills. Bondy and Frost (1994) originally developed PECS "for use with preschool children with autism, pervasive developmental disorders, and other socio-communicative disorders who display no functional or socially acceptable speech" (p. 2).

The entire training system consists of six phases that "progress from teaching children how to communicate using the pictures in a manner which is important to the child, to the use of multipicture sentences, and then to the use of a variety of communicative functions" (Bondy & Frost, 1994). In Phase I the picture exchange is taught. In Phase II "spontaneity of the exchange" is taught by increasing the distances between the participant and the trainer and between the participant and the pictures. In Phase III the participant is taught to distinguish between pictures. In Phase IV the participant is taught to make requests by forming sentences with the use of an additional "I want" card. In Phase V the participant is taught to respond to the question "What do you want?" by using sentences. Finally, in Phase VI participants are taught to name an item rather than request an item by responding to the question "What do you see" without being reinforced by receiving the item in the picture.

PECS procedures were intended to offset some of the shortcomings of traditional picture-pointing systems. First, individuals are taught to request or mand for things before they are taught to name or tact things. Skinner (1957) defined a *mand* as "a verbal operant

in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation" (pp. 35-36). Skinner defined a *tact* as "a verbal operant in which a response of given form is evoked (or at least strengthened) by a particular object or event or property of an object or event" (pp. 81-82). Mands produce consequences that benefit the speaker directly and should be acquired more quickly than naming (Sundberg & Michael, 2001).

Second, PECS does not require an individual to point, thus the system should be usable by individuals who have difficulty pointing, although PECS does require an individual to pick up a picture, which could be difficult for some individuals. Third, there are no verbal prompts used to teach PECS; therefore, there is less likelihood that an individual would become dependent on verbal prompts. Finally, since PECS includes teaching the individual to seek out a facilitator to exchange a picture for the corresponding item, this behaviour is less likely to be extinguished than pointing for the reason noted above.

PECS Research

Lancioni et al. (2007) reviewed literature relating to both PECS and VOCAS between 1992 and 2006. They reviewed 17 studies describing the use of PECS or equivalent systems (i.e., requesting items by pointing to pictures of the items) and reported that 170 of 173 (98%) of the students in the studies succeeded to varying degrees. But, the authors also identified two very important considerations related to the PECS literature. First, they noted that “the articles with the largest number of students exposed to PECS provided only narrative accounts or summary group data (Bondy & Frost, 1993; Liddle, 2001; Magiati & Howlin, 2003; Schwartz, Garfinkle & Bauer, 1998)

that did not allow one to quantify the amount of teaching carried out and the number of stimuli included for the single students" (p. 14). Second, they suggested that "reports of various levels of progress over relatively extended periods of time (e.g., Liddle, 2001; Magiati & Howlin, 2003; Schwartz et al., 1998) could be considered difficult to interpret and even slightly ambiguous given that no specific design or procedural controls were used" (p. 14), implying that learning may have been confounded by maturation effects or learning through other means (e.g., imitation). Based on their review, Lancioni et al. concluded "that PECS and VOCAs are similarly effective systems for introducing students with developmental disabilities and lack of speech to making requests" (p. 17), but they also suggested caution with regard to the general outcome of the studies reviewed due to the limitations they identified above.

Descriptive reports of PECS with persons with autism or intellectual disabilities. Bondy and Frost (1994) introduced PECS to a 3-year old boy with autism with no speech. The sixth phase was reached after 4 months of training and his picture repertoire grew to over 100 pictures over the next few months while his speech, which he used while communicating with pictures, became clear enough to be effective with strangers. As such, pictures of the strongest words spoken were gradually removed and after 11 months he used speech alone to communicate.

Schwartz et al. (1998) taught PECS to 31 children with severe disabilities. Sixteen of the children were diagnosed with autism or a pervasive developmental disorder. The other 15 children were diagnosed with Down syndrome, Angelman's syndrome, or other developmental disabilities. All 31 children learned the fundamental PECS protocol (Phases I through III) within 11 months on average, and then they learned to exchange

with both typically developing and children with disabilities in an additional three months. Because only descriptive data are reported, conclusions about the efficacy of PECS training are difficult due to a lack of an experimental design.

Webb (2000) introduced PECS to 6 children (aged 4 to 6) with an autistic disorder and severe learning difficulties. Five of the children had severe communication difficulties. After 6 months of PECS training, the participants reportedly used hundreds of pictures and increased spoken language from a baseline average of 10 to a follow-up average of 68 words. The researcher and parents reported big improvements in the children's communication skills.

Liddle (2001) taught PECS to 6 children with autism who had little or no functional language. After one month 3 children completed the first three phases, one completed two phases, one completed one phase, and one had no success.

Magiati and Howlin (2003) investigated the effects of PECS, as taught by teachers, teacher assistants, and related staff, on 34 children with autism spectrum disorder. Data collected revealed impressive increases by the students in level of PECS attained, the PECS vocabulary used, and the frequency of PECS usage. Small improvements in the children's general level of communication and adaptive behaviour were also reported.

In each of the five studies described above only descriptive data are reported. Conclusions are difficult due to a lack of experimental design.

Empirical investigations of PECS with persons with autism. A thorough search of the literature yielded six published empirical investigations of PECS with persons with autism.

In a multiple-baseline design, Charlop-Christy, Carpenter, LeBlanc, and Kellet (2002) investigated the effects of PECS training on acquisition of communication skills, emergence of speech, social-communicative behaviours, and problem behaviours in free-play and academic settings. The 3 participants were boys with autism, aged 3-years 8-months, 5-years 9-months, and 12 years, who did not speak or rarely spoke, despite extensive histories of verbal speech training. The 3-year old had an overall functioning ability in the 10-month to 18-month range according to the Vineland Adaptive Behavior Scales. The 5-year old had a receptive vocabulary of less than 1 year 9 months on the Peabody Picture Vocabulary Test (PPVT). The 12-year old had an expressive language age-equivalent score of 1 year 2 months on the Minnesota Child Developmental Inventory and a receptive vocabulary age-equivalent score of 1 year 9 months on the PPVT. Each child also "demonstrated 2-dimensional discrimination skills in ongoing curricular assessments" (p. 217), meaning that picture discrimination skills which are taught in Phase III of PECS were already present in these children. In addition to learning all phases of PECS in an average of 246 trials (or 170 minutes), all participants showed an increase in verbal speech, increases in social-communicative behaviours, and decreases in problem behaviours. While initiation of PECS training was contingent on the stability and trend in vocalizations in play and academic settings, no baseline assessment of PECS skills was reported and the number of pictures taught was not specified. While inter-observer agreement on outcome measures was high, treatment integrity checks were not reported, meaning we do not know how reliably the training procedures were carried out as described.

Kravits, Kamps, Kemmerer, and Potucek (2002), in a multiple-baseline across settings design, examined the effects of PECS Phases I to III on the spontaneous communication skills of a 6-year-old girl with autism across home and school environments. Prior to the intervention, the participant could respond to prompts with 1- to 2-word utterances, but seldom initiated this form of communication. All sessions consisted of a teaching period (5-10 trials) followed immediately by a play period (15-20 minutes), during which access to available items and activities was contingent on requesting using PECS. Seventy-one trials over 5 training sessions were required to learn to request items during leisure and snack times at home, while 41 trials over 8 sessions were required during free-play time at school. An additional condition which followed mastery of PECS involved a combination of PECS and social skills enhancement training that was aimed at increasing the duration of the participant's interactions with peers. Problems of interpretation and ambiguity of the results could be raised due to the mixture of teaching and playing trials (Lancioni et al., 2007) and the lack of generalization or follow-up probes. Inter-observer reliability data were reported, but treatment integrity data were not.

Ganz and Simpson (2004), in a single-subject changing-criterion design, investigated the role of PECS acquisition on increasing words spoken, increasing the complexity and length of phrases, and decreasing the non-word vocalizations of 3 children (ages 3, 5, and 7) with autism spectrum disorders and developmental delays. The 3-year old had a Battelle Developmental Inventory age equivalency of 2 years, 2 months. The 5-year old had a Vineland Adaptive Behavior Scales age equivalency of 0 years, 7 months. The 7-year old had no current assessments. Participant inclusion criteria included

no prior experience with PECS, including observing others using PECS (as well as pre-verbal or limited functional speech), but no baseline assessment of PECS skills was reported. The participants were taught phases I to IV of PECS. All 3 participants progressed through the PECS training in 222 to 368 trials. The number of pictures taught was not reported, although the authors indicated that each participant has a minimum of 20 colour line drawings and photos by the end of training. The lack of baseline skills assessment makes it impossible to interpret these results. Treatment integrity data were also not reported.

In an alternating treatments design, Tincani (2004) compared the effects of PECS and sign language acquisition on requests for preferred items and vocal behavior by two students: a 5-year old boy with autism in the severe range (no IQ or age equivalent assessments reported) and a 6-year old girl with a diagnosis of pervasive developmental disorder-not otherwise specified and an IQ of 54. Baseline assessments indicated that neither student had a preexisting ability to request preferred items with picture exchange, speech, or sign language. For one student, sign language training led to a higher percentage of requests for preferred items and was selected as the “best treatment” before PECS was completed. This student also emitted more than twice as many word vocalizations in sign training than in PECS training. The other student completed phases I through III of PECS. For this student, PECS was selected as the “best-treatment”. This student also emitted more word vocalizations in sign language training than in PECS training, and a decline in word vocalizations in PECS training corresponded with an increase in independent picture exchange. The author speculated that further PECS training (i.e., Phases IV to VI) may have resulted in greater frequencies of vocalizations

since Bondy and Frost (1994) reported that development of vocalizations often occurred in these latter phases. Acceptable inter-observer agreement and procedural integrity data were reported.

Tincani, Crozier, and Alazetta (2006) examined the effects of learning phases I through IV of PECS on manding and speech development for two school-aged children with autism in a multiple-baseline design. Each session consisted of up to 30 response opportunities. One participant did not complete PECS before the study was concluded, but mastered Phase II after 29 sessions. The other participant mastered Phase IV after 31 sessions. The study included a baseline assessment of PECS skills, as well as acceptable inter-observer agreement and treatment integrity data.

Carr and Felce (2007) provided 15 hours of training of PECS Phases I and II to 24 children with autism. The mean age of the group was 5-years, 5-months. The study used both a within-subjects measure and a between-groups measure. Communicative initiations and dyadic interactions between the children and the teachers increased significantly for the PECS group but not for the control group. Treatment integrity data were not reported.

Thus, the empirical support of PECS with individuals with autism is limited to the 35 children, aged 3 to 12, in the six studies described above. Of these 35 children, 33 had demonstrable success with PECS while one had better results with manual sign.

Empirical investigations of PECS with persons with intellectual disabilities. While PECS was originally intended for children with autism, teaching functional requesting skills to nonspeaking adults with intellectual disabilities is also important. First, these individuals may have long histories of engaging in challenging behaviours to

gain access to reinforcers (Chambers & Rehfeldt, 2003). Second, providing choice can improve behaviours (Kern et al., 1998). Finally, enabling individuals to access preferred items can increase happiness (e.g., Green, Gardner, & Reid, 1997). The following is a review of empirical investigations related to PECS use with persons with developmental disabilities.

In an alternating-treatments design, Chambers and Rehfeldt (2003) compared the effectiveness of PECS (Phases I through III) and manual sign training on the acquisition of requesting skills by 4 adults (aged 19 to 40) with mental retardation in the severe and profound range (IQs ranged from less than 18 to 27). During baseline assessment of PECS participants had access to a binder with pictures of preferred and distracting items and were given 5 s to hand the experimenter a picture of the preferred item that was present on each trial. Similarly, manual sign baseline skills were assessed by giving participants 5 s to emit the sign corresponding to the preferred item present on each trial. None of the participants requested items using pictures or sign during baseline. All participants could match 2-dimensional pictures to 3-dimensional objects, and vice versa, prior to training, meaning that discrimination skills taught in Phase III of PECS were already present for all participants. Each participant was taught the same four requests using manual sign and PECS. Three of the participants learned to request their four preferred items using PECS and demonstrated generalization of requests using PECS across settings. Two of the participants successfully completed manual sign training, although it took them longer to learn sign (20 and 26 10-trial blocks) than it took them to learn PECS (15 and 16 10-trial blocks). These 2 participants also demonstrated generalization of requests using manual sign across settings. The fourth participant was

withdrawn from the study part way through due to illness, but showed more success with PECS. This study suggests that PECS may be learned more broadly and more efficiently than manual sign. Treatment integrity data were not reported.

Bock, Stoner, Beck, Hanley, and Prochnow (2005) used an alternating treatments design to compare the effectiveness of PECS (Phases I through III) and VOCAs with 6 non-speaking 4-year old boys with developmental delay who did not use an AAC system. Participation criteria also included current education in a preschool setting and the abilities to physically manipulate and visually locate a laminated 5 by 5 cm picture. Baseline procedures involved placing in front of the participant 3-4 items, pictures of those items, and a VOCA with the corresponding pictures attached. Three separate 10 minute sessions were conducted and the number of times a picture was exchanged with an observer or a location on the VOCA was activated were recorded. A stable baseline of 0% accuracy with PECS and VOCA systems was established prior to treatments. The observer did not interact with the child other than to facilitate the requests. Because of scheduling limitations, the interventions were limited to five and a half weeks. During this time all participants were showing progress with both systems. Two participants successfully completed Phase III of PECS while no participant completed VOCA training. For 3 of the children, PECS skills were acquired at a slightly higher rate than VOCA skills. Generalization of spontaneous requests with both systems was demonstrated in a classroom setting by 5 participants. The major limitation of this study was its short duration. The study was terminated before 3 participants could attempt completion. Inter-observer agreement data were reported while treatment integrity data were not.

In a multiple-baseline design, Rehfeldt and Root (2005) investigated whether a reinforced history of relational responding would result in derived requesting skills in 3 adults (aged 20-34) with severe mental retardation. As part of the procedures participants were taught PECS Phases I through III. The participants had IQs ranging from 21 to 30 and rudimentary or no functional communication skills. None of the participants requested items using pictures during baseline. All 3 participants were taught to request their three preferred items using pictures in 11 to 15 9-trial blocks. Treatment integrity data were not reported.

A modified ABAB single-subject design was used by Stoner et al. (2006) to examine acquisition of PECS (Phase I through IV) during training sessions for 5 adults (aged 22 to 30) with mental retardation, IQs ranging from 20 to 49, who had no verbal skills and no functional communication system. Baseline PECS requesting skills were assessed using the following procedure: The experimenter placed a picture of a desired item and the actual item in front of the participant while extending her or his open hand toward the participant. Errors were not corrected and verbal cues were not provided. The participant was given 10 opportunities across 3 consecutive days to pick up the picture and hand it to the experimenter. A stable baseline of PECS skills was established prior to introducing the first treatment condition of 3 sessions of PECS training per week. After several weeks, PECS training was withdrawn for 3 sessions and baseline PECS skills were reassessed using the same procedures described above. PECS training was then reinstated at the phase determined by the participant's performance at the end of the first treatment condition. Three of the participants progressed through the four PECS phases in less than 20 intervention sessions (sessions lasted at least 15 minutes or until at least 10

trials were provided). The other 2 participants demonstrated limited progress. For one of the participants, little progress was made after 11 sessions in Phase II. Despite this, the experimenters attempted discrimination training between 2 objects for 4 sessions, but with no progress seen. For the other, slow but steady progress was being made before the student was withdrawn from the study due to health concerns as the cognitive and motor demands required to use PECS functionally were compromised.

Across the four empirical investigations involving PECS with individuals with intellectual disabilities described above there were 18 participants, aged 4 to 40. Of these, 11 completed the final phase of PECS that was taught, 3 were demonstrating success before their study was terminated, 2 showed little progress, and 2 were removed from their study due to health concerns.

Statement of the problem

The first PECS training manual was published in 1994 (Frost & Bondy, 1994), yet the first empirical investigations of PECS were reported much later (Charlop-Christy et al., 2002; Kravits et al., 2002). Since then, there have been eight additional empirical studies (Bock et al., 2005; Carr & Felce, 2007; Chambers & Rehfeldt, 2003; Ganz & Simpson, 2004; Rehfeldt & Root, 2005; Stoner et al., 2006; Tincani, 2004; Tincani et al., 2006). Across the 10 published empirical investigations with PECS (i.e., those looking at either autism or other intellectual disabilities) with a combined total of 53 participants, 45 completed the highest level trained, 5 demonstrated at least some success before their study was terminated, 2 had little success, and 2 were withdrawn. Furthermore, a number of these investigations have at least one weakness such as a lack of procedural integrity assessment (e.g., Bock et al., 2005) or baseline assessment of PECS skills (e.g., Ganz &

Simpson, 2004). Moreover, since Phase III of PECS requires participants to be able to select between 2-dimensional pictures to obtain the items they represent, visual discrimination between pictures and matching pictures to objects may be needed to learn to use PECS functionally. Therefore, participant baseline discrimination skills should also be assessed and reported.

The purpose of this study was to empirically evaluate the acquisition of PECS Phases I through III for three nonspeaking adults with intellectual disabilities using a modified multiple-baseline design across participants. Baseline assessment of PECS skills and discrimination skills were conducted prior to training. Inter-observer reliability and procedural integrity data were also collected.

After baseline assessments, because the participants were already able to perform the skills in PECS Phases I to II, training focused only on PECS Phase III: correspondence between selecting a picture followed by selecting the item depicted in the selected picture.

Method

Participants and Setting

Three adults with intellectual disabilities were recruited from River Road Place, St.Amant, a residential and resource facility for people with intellectual disabilities. Participant 1 was a 38-year-old female, with a diagnosis of severe intellectual disabilities according to her health record. According to her speech and language pathologist she had no history of functional communication, although she was thought to have the general knowledge that if she pointed to a picture on a communication board she would get something. Participant 2 was a 47-year-old male, with multiple diagnoses including

severe mental retardation, Down syndrome, and suspected Alzheimer. According to his speech and language pathologist he had no history of functional communication. Participant 3 was a 52-year-old male, with a diagnosis of moderate intellectual disabilities. According to his speech and language pathologist he had a history of some functional communication using a picture book, but use of this book was discontinued when he was 50 years of age due to challenging behaviours that occurred when he was prompted to use the book. All participants scored in the "Low Level" on the Vineland Communication subdomain (Sparrow, Ball, & Cicchetti, 1984) when assessed by the experimenter in consultation with each participant's speech and language pathologist, and all participants were able to learn to perform the visual quasi-identity matching-to-sample discrimination, Level 4 (but failed the subsequent Level 6, an auditory-visual discrimination) on the *Assessment of Basic Learning Abilities* (ABLA; Kerr, Meyerson, & Flora, 1977; Martin & Yu, 2000). The passing criterion for all ABLA levels is 8 consecutive correct responses, and the failing criterion for all levels is 8 cumulative errors. All participants had the motor dexterity to pick up a picture card. Participant 1 could not walk but used a manual wheelchair and could move herself around using her legs. Participant 2 could walk. Participant 3 could not walk but used a manual wheelchair and could move himself using his hands and arms.

Individual sessions took place in a quiet room at River Road Place, three to six times each week depending on the participant's availability. The study received ethical approval from the University of Manitoba Psychology/Social Research Ethics Board and written informed consent was obtained from each participant's legal guardian before the study began.

Materials

A 3-ring binder (approximately 25.5 cm by 29 cm) was used as a communication board to teach PECS. The binder contained several strips of Velcro® on the front cover. Colour photographs (10 cm by 10 cm) of preferred items could be attached to the binder.

Preference Assessment to Identify Training Stimuli

A multiple-stimulus without replacement preference assessment (DeLeon & Iwata, 1996) was conducted to identify stimuli for training. First, direct care staff members who worked with the participants were asked to provide a list of food and leisure items that the participant liked and indicated how often those items were typically available to her or him. The same staff members were also asked to provide a list of food and leisure items that the participant either did not like or had no interest in. Items from these lists were used in the assessment. Each preference assessment session was conducted until 25 trials were completed or until 30 minutes had elapsed. One to three sessions were conducted for each of two sets of five edibles until a clear preference ranking was observed in the data.

During each assessment session, 5 items were placed about 10 cm apart in a line on a tray. Participants were seated in front of a table. The tray was placed on the table in front of the participant and he or she was asked to “pick one”. Immediately after the participant made a selection, the tray was removed. The participant was allowed to consume the edible or engage with the item (if it was an activity) for about 30 s. On the next trial the remaining items were presented, and this was repeated until all items had been selected, including the last item. Positions of the items for the first trial of each set of 5 trials were counterbalanced. For trials 2-5 of each set of 5 trials the positions were

rotated. Out of the 10 items tested, the four which were, on average, selected earliest in the trial sequence were considered higher preference (HP) and were used for PECS Phase III training, while items that were, on average, selected latest in the sequence were considered lower preference (LP) and were used during training if less-preferred "distracter" items were needed. The preference assessment described above was conducted for all participants with one exception: for Participant 1, originally one set of five tangible items was assessed in one 25-trial session using the procedure described above. A clear ranking in the data was observed and the items were used during training. The preference assessment was later omitted for Participant 1 when identifying new tangible items to use during training (Phases A1 and B). Instead, for these Phases, two sets of four tangible items were selected arbitrarily by the experimenter. A preference assessment was not conducted with these items because (a) of potential satiation to the items and (b) subsequent training sessions did evoke the necessary differential choice responses across items (i.e., the participant demonstrated clear preferences in training trials) .

Baseline Assessment of PECS Usage

Each participant's ability to request preferred items using pictures was assessed using procedures similar to those described by Stoner et al. (2006). At the beginning of the first session, a demonstration of the correct responses (1 trial) was provided in which one "trainer" played the role of the participant and a second "trainer" played the role of the experimenter. A session consisted of 8 to 15 trials (depending on the participant's rate of responding). At least 8 trials were conducted using two pictures (2-choice), three pictures (3-choice), and four pictures (4-choice), respectively, for each participant.

To begin a trial, Trainer 1 attached two, three, or four colour pictures of the desired items (determined in the preference assessment) to the outside cover of a binder, placed the binder 3 m away from the participant, moved 3 m away from the binder, extended her or his open hand towards the participant, and provided the verbal prompt, "(first name), use the pictures to show me what you want". The participant was expected to emit the following behaviours: (1) go to the binder (by walking or moving self in a manual wheelchair); (2) remove a picture from the binder; (3) bring the picture to Trainer 1; (4) release the picture in Trainer 1's hand; and lastly (5) when offered a tray containing all of the items corresponding to the pictures on the binder, select the item that corresponded with the chosen picture. The participant was allowed 10 s to initiate each step. If the participant performed a step incorrectly (e.g., moved past the binder without picking up a picture), or stopped making progress for 10 s towards completing a step, Trainer 2 would physically assist the participant to move to the next step. No additional prompts were provided. Trainer 1 recorded each step as correct (defined as performing the step correctly as described above without assistance) or incorrect (defined as not initiating the step within 10 s, performing the step incorrectly, or pausing for 10 s). Criterion for mastery of each of these five steps was independent completion of each step across three consecutive trials.

Overview of General Training Procedures and Design

The results of the baseline assessments showed that all three participants were able to perform all but step 5 – selecting the item that corresponded with the picture that the participant had previously selected. Therefore, training focused on improving correspondence between picture and item selections. The original goal was to teach the

participants to select a desired item from an array of 4 pictures of preferred items and to exchange the selected picture with the corresponding item. However, the picture array was reduced from 4 to 2 because of the considerable training required to meet criterion.

Each training session consisted of 15 to 20 trials, depending on the participant. Each session required two trainers, and three people rotated as trainers across sessions to promote generalization. Training for each participant involved a fading program implemented in a modified multiple-baseline design across participants. It was necessary to individualize the fading programs for Participants 1 and 2 (described below) based on the problems encountered by each participant as training progressed. Therefore, the specific dimensions of the stimuli that were faded differed across participants. Participant 3 did not receive training because he showed improvement across baseline sessions.

Training Procedures for Participant 1

Participant 1 performed at chance level with 2, 3, and 4 pictures during Baseline. The training goal for Participant 1 began with an array of 4 pictures. The training target for Participant 1 was reduced to 2 pictures because of the difficulties she encountered.

Phase A: 4-choice training. The training procedure was a fading program, starting with training trials involving two pictures. The plan was to add one picture after the participant performed correctly for 3 consecutive trials, until 4 pictures were involved. The general trial presentation procedures are described below.

The participant was seated in front of a table across from a trainer. The trainer placed two to four pictures side-by-side, approximately 20 cm apart, on the table in front of the participant, instructed the participant to “pick one”, and provided up to 10 s for a response. Touching a picture was considered a selection. If the participant did not select a

picture within 5 s, the instruction was repeated. If the participant did not select a picture within 10 s the trainer stopped the trial, removed all materials from the table, waited 15 s, and then presented the next trial. If the participant selected a picture the trainer removed any unselected pictures and placed all the items depicted in the pictures that were originally presented on the table in front of the participant. The trainer then asked the participant to "pick one". If the participant did not attempt to select an item within 10 s (recorded as "no response") the trainer stopped the trial, removed all materials from the table, waited 15 s, and presented the next trial. If the participant attempted to take an item that did not correspond to the picture selected (recorded as an "incorrect response"), the trainer physically blocked the participant gently from taking the item, stated "no, that's not it", and ended the trial. If the participant attempted to take the item depicted in the picture selected earlier (recorded as a correct response), she was allowed to interact with the item for 30 s and the trainer immediately praised the participant. At the end of each trial, the trainer removed all materials from the table, waited 15 s, recorded the participant's response as defined above, and then presented the next trial. The criterion for increasing the number of pictures was three consecutive correct responses. The criterion for decreasing the number pictures was three cumulative incorrect responses. Twenty three training sessions (373 trials) were provided to Participant 1 during this phase. The mastery criterion was set at two consecutive training sessions with 80% correspondence or better. The probability of meeting this criterion by chance, assuming the responses are independent, is extremely small.

Phase A1: 4-choice training with new materials. Because of the lack of progress in the preceding phase and to address the possibility of satiation to the training materials

two sets of four new training items were utilized in subsequent training sessions. The set of four items used each session was also alternated to minimize satiation to the training materials. Finally, the time given to Participant 1 to interact with the item after she selected it was reduced from 30 s to 10 s to further minimize satiation. Other than the use of new materials the procedures for sessions in this phase were identical to Phase A. Nine training sessions (135 trials) were provided during this phase.

Phase B: 2-choice training. Because of the lack of progress in the preceding phases the training procedures for this phase were altered in two ways. First, the training goal was switched to select a desired item from a 4-choice array to a 2-choice array. Therefore, all training trials involved only 2 pictures and fading to 3-choice and 4-choice trials was eliminated. Second, after 12 training sessions in this phase, an attending response to each item (touching each item) was added on each trial before Participant 1 was asked to select an item. To ensure the participant had attended to each picture, the trainer asked the participant to touch each picture which was presented at eye level one at a time and praised the participant for doing so. If the participant did not touch the pictures within 5 s, the trainer repeated the request. After the participant touched both pictures the trainer placed the two pictures side-by-side on the table and continued with the procedure as described in Phase A except that all trials involved only two pictures. Fifteen training sessions (224 trials) were provided during this phase.

Training Procedures for Participant 2

Participant 2 performed at chance level with 2, 3, and 4 pictures during baseline. The training goal for Participant 2 also began with an array of 4 pictures. Given the difficulty encountered by Participant 1 with 4 pictures, Participant 2 began training with 2

pictures only. The plan was to progress to 3 and then 4 pictures if Participant 2 could master 2 pictures fairly quickly.

Phase A: 2-choice (HPs). The training procedures during this phase were the same as those used during Phase B for Participant 1 except that both items were HPs. Eight training sessions (118 trials) were provided during this phase.

Phase B: 2-choice training (HP and LP). Because Participant 2 performed at chance level in Phase A, during this phase all training trials involved 1 HP and 1 LP picture. Three training sessions (45 trials) were conducted during this phase.

Phase C: 2-choice training, picture and position fading. Because Participant 2 continued to perform at chance level in Phase B, 5 fading steps were inserted leading up to the final target discrimination in Phase B. Step 1 involved using only one picture and it was always a HP picture (4 HP pictures were rotated across trials). Step 2 involved one HP picture and one blank picture card located 30 cm behind the HP picture. From Steps 3 through 5, the blank picture card was moved forward systematically until it was even with the HP picture. This phase was presented for 13 sessions (196 trials).

Phase D: 2-choice training, edibles in cup. Because Participant 2 continued to perform at chance level in Phase C once the blank picture was even with the HP picture, in Phase D small translucent medicine cups were placed on top of the HP picture and the blank picture at the beginning of each trial in order to try to increase the salience of the food stimuli. The cup on the HP picture held a small amount of the food depicted in the picture, whereas the cup on the blank picture card was empty. Four sessions were conducted in this phase (60 trials).

Phase E. Because of the lack of progress in the preceding phases, a new procedure using direct response-reinforcer relation was introduced in this phase. An opaque apparatus with two transparent and hinged doors was constructed (see Figure 1). Initially, on each trial food was placed behind one door and the participant was then prompted to "pick one". The participant could see the food through the transparent door and could lift the appropriate door to retrieve the food item. The goal was to systematically fade-in (1) the second food stimulus and (2) the pictures (by pasting portions of the pictures onto the doors until they were fully covered by the pictures. This procedure was terminated after 18 sessions (267 trials) due to a lack of progress.

Phase F. This phase involved presenting the food stimuli in a different form and in some of the steps fading in picture stimuli using boxes covered on all sides by the pictures. First, a fading step was inserted at the beginning (i.e., which became Step 1) that involved only one high preference picture. Second, a teaspoon was included on the tray, centered between the two foods with the handle resting on the front lip of the tray. The participant was permitted to consume whichever food was selected using the spoon and received brief social praise from the trainer. The participant was not required to select a picture, although pictures were presented. The pictures used on each trial corresponded with the two food items used and their positions depended on the fading step. The initial position of the pictures was approximately 20 cm behind the food items and 13 cm to each of the outside sides of the food items (see Figure 2). The pictures stood vertically to maximize their visibility from the participant's perspective. Pictures were moved one position closer (approximately 6 cm, initially) following 5 consecutive correct trials and were moved one position farther following 3 cumulative errors. The picture fading

positions, initially about 6 cm apart, were to be moved smaller distances as the participant progressed (several of the final steps were only 1 cm apart), and the positions of the pictures across the fading steps followed a path like a letter "J" until they stood directly in front of the food items. Based on the participant's performance, the above procedures were modified further as follows:

a. Within 4 sessions the vertically standing pictures were faded in until they were positioned standing directly in front of the foods, but the participant did not appear to be attending to the pictures (e.g., he moved his body to be able to look over top of and/or around pictures at the foods before making a selection).
b. For the next 5 sessions, boxes with pictures on all sides replaced the vertically standing pictures. The participant was required to lift the boxes to access food. Several trials with hand-over-hand physical prompts were required to teach the participant to lift the box to access the foods. The foods presented in each trial were covered with 20 cm x 20 cm x 20 cm boxes with pictures of the corresponding foods attached to all sides of the box (except the open bottoms). Initially, the box with the lower preference pictures and food item was placed in the fourth of four positions marked on the tray, farthest from the participant (but approximately 30 cm behind the position of the high preference picture). The box with the lower preference pictures and food was moved one position closer (approximately 10 cm) following 5 consecutive correct trials (to a maximum of parallel with the higher preference picture), and was moved one position farther away from the participant (approximately 10 cm) following 3 cumulative errors (to a minimum of position four).

c. For the next 7 sessions, the lower preference food and boxes with pictures on all sides was replaced with a black box (same dimensions) with no food inside. As such, the participant's selection was reinforced differentially as no food was available when the black box was selected.
d. Across sessions 13-16, pictures of a less preferred food were gradually introduced on the black box. The picture was added to the rear first, followed by the left side, the right side, the front, and finally the top.
e. For the next 9 sessions, the trainer started taking the box when selected by the participant and the consequence (access to the food selected) was provided after the box was given to the trainer.
f. For the next 10 sessions, an attending component was added to the procedure which required the participant to look at both boxes with pictures at the beginning of each trial prior to being prompted to make a selection.
g. For the last 6 sessions in Phase F, the black box was now covered on all sides with pictures of the less preferred food. Next, fading steps involved reducing the height of the boxes across 4 steps until the participant's only picture cue was the 2-dimensional picture on the top of the box.

Follow-up Probes. Retention of the participants' discrimination skills was assessed using the baseline procedures described earlier to examine if the newly acquired skills remained. Follow-up probes occurred at five, 16, and 22 days after mastery of discrimination for Participant 1, while follow-up probes occurred at one, three, 23 days, and 59 days after mastery of discrimination for Participant 2.

Reliability

Inter-observer agreement on dependent measures. An independent observer collected trial data either live or from video records of sessions and data were compared to the trainer's recordings. A trial was defined as an agreement if the same response was recorded by the trainer and the observer, and a disagreement if different responses were recorded. Percent agreement per session was calculated by dividing the number of agreements by the sum of agreements and disagreements, and multiplying by 100 (Martin & Pear, 2011). For Participant 1, reliability checks were conducted for 57% of her baseline trials, 66% of her training trials, and 33% of her retention trials. For Participant 2, reliability checks were conducted for 41% of his baseline trials, 81% of his training trials, and 92% of his retention trials. For Participant 3, reliability checks were conducted for 45% of his baseline trials. Average percent agreement per session was 100% (range, 98 to 100%) for Participant 1, 99.6% (range, 60 to 100%) for Participant 2, and 99% (range, 94 to 100%) for Participant 3.

Procedural integrity. During reliability checks, procedural integrity checks (whether the trainer followed the planned procedures) were also conducted using a behavior checklist. Checklists consisted of 9-15 behaviours for a baseline trial, 4-9 behaviours for a training trial depending on the stage of the training, and 9-11 behaviours for a retention trial. The number of behaviours depended on whether the participant made errors during the sequence. Checklist items included whether the trainer set up the materials correctly (e.g., binder was placed 3 m from the participant with pictures showing), gave the correct verbal instructions, allowed the appropriate amount of time for responding, and provided the appropriate consequences on each trial (see Appendices A

to J for checklists). A trial was defined as carried out correctly if all the steps were followed; otherwise, it was considered an error. The percentage of trials per session carried out correctly was computed. Procedural integrity checks were conducted during 70% of the sessions for Participant 1, 75% of trials for Participant 2, and 52% for Participant 3. The mean percentage of correct trials per session was 100%, 99%, and 100% for Participants 1 through 3, respectively.

Results

PECS Phases I and II

During initial baseline probes all three participants were able to consistently demonstrate the skills required for the first two phases of PECS, which involved (1) traveling 3 m to the binder, (2) removing one picture from the top of the binder, (3) taking the picture 3 m to the trainer, and (4) releasing the picture in the trainer's hand. Participant 1 was successful in reaching criterion (independent completion of each step across three consecutive trials) for all four steps after 15 trials. Participant 2 was successful in reaching criterion for Steps 2-4 after 24 trials. Participant 2 required a light physical prompt to begin the first step, but once initiated he was consistently able to complete the step without further prompting after 15 trials. Participant 3 was successful in reaching criterion for all four steps after 9 trials. Since all 3 participants demonstrated mastery of the four skills required for PECS Phases I and II, no training was provided for these components.

PECS Phase III: Correspondence Training

Figure 3 shows the percent of correspondence during baseline and training phases for the participants. Filled squares indicate baseline assessments involving 4 choices

(pictures), filled triangles indicate baseline assessments involving 3 choices, and filled circles indicate baseline assessments involving 2 choices. Unfilled circles denote training data in the respective training phases.

During the first baseline session involving four high-preference items (a small jewelry container with plastic jewelry inside, a Tigger® keychain, a handheld mirror, and a hand clapper), Participant 1 selected the item that corresponded with the exchanged picture on 27% of the trials (top graph in Figure 3).

After the first 15 training sessions (153 trials) in Phase A, Participant 1 did not meet criterion on 4-choice. She oscillated between 2- and 3-choices in the fading program and did not reach 4-choice. Given the difficulty with Participant 1 progressing to 4-choice trials, 2-, 3-, and 4-choice baseline probes were conducted at this point in anticipation of needing to later reduce the training goal from four to three or two pictures. During these baseline probes correspondence was 84% for 2-choice, 65% for 3-choice, and 53% for 4-choice. Phase A training was then resumed and after another 8 training sessions (120 trials) Participant 1 still did not meet criterion, reaching 4-choice on only one trial. Furthermore, she appeared to lose interest in the training items (e.g., by not interacting with the item she had selected). Therefore, a new baseline session was conducted each for 2-choice, 3-choice, and 4-choice, respectively, to identify new items for training. Percent correspondence was 50% for 2-choice, 63% for 3-choice, and 38% for 4-choice. The new pictures used included Mr. Potato Head®, Mrs. Potato Head®, a necklace of beads, a squishy ball, a small package of plastic jewelry, a plastic jeweled crown, bubble solution with a bubble wand, and a tennis ball.

During Phase A1 (4-choice training with new items) using two, three, or four pictures, Participant 1 did not meet criterion after 9 sessions (135 trials). She oscillated between 2 and 3 pictures for 126 of the 135 trials and only reached 4 pictures during three sessions. At this point, the decision was made to focus on 2-choice training and therefore, the training target was reduced from 4 to 2 pictures in Phase B.

After 15 training sessions in Phase B using only 2 pictures and items on all trials, Participant 1 met the criterion of 80% correct for 2 consecutive sessions. During the three follow-up assessments, she performed at 88% correspondence 5 days after training, at 75% correspondence 16 days after training, and lastly at 75% correspondence 22 days after training.

The results of Participant 2 are shown in the middle graph of Figure 3. During baseline assessments, Participant 2's percent correspondence was near chance levels on 2-choice (M = 46%), 3-choice (M = 30%), and 4-choice (M = 20%) assessments. Items assessed included strained carrots, strawberry-apple snack, creamed corn, and apple sauce.

During Phase A where both items were HPs, Participant 2's percent correspondence averaged only 45% out of 118 trials. During Phase B (3 sessions), when a picture of a higher preference food and a picture of a lower preference food were presented on each trial, Participant 2's percent correspondence averaged 51% out of 45 trials. During the next 13 sessions (Phase C, HP and blank with position fading), Participant 2's percent correspondence showed an initial improvement but it was not sustained. The initial improvement was expected because only one picture was presented alongside a blank (white) picture and the target picture was closer to the Participant.

Participant 2's performance, however, returned to near chance level once the position prompt was faded out. During the next 4 sessions (Phase D) when the food items were presented in medicine cups on top of the pictures, Participant 2's percent correspondence averaged 63% out of 60 trials. The participant, though, frequently selected the blank picture with an empty medication cup on it. Based on these results, the procedures were modified. During the next 18 sessions (Phase E), which involved the apparatus (Figure 1), Participant 2 selected his preferred item from inside the apparatus on 71% of the trials. Despite the inclusion of the attending prompts, Participant 2 appeared not to scan both apparatus openings and routinely selected items from the right hand side of the apparatus. This phase was discontinued before pictures were introduced.

Phase F was implemented in the next 41 training sessions (818 trials). Within 4 sessions, the vertically standing pictures were faded in until they were positioned directly in front of the foods. HP food was selected on 93% of the 90 trials, but the participant did not appear to be attending to the pictures (e.g., he looked over top of and/or around pictures to identify the food before making a selection). During the next 5 sessions, the participant was required to lift boxes with pictures on all sides to access foods. He selected the higher preference food on 81% of 97 trials, although he did not meet criteria once the LP box (initially located in the fourth farthest of four positions on the tray) was parallel with the HP food. For the next 3 sessions, during which the lower preference food and boxes with pictures on all sides was replaced with black box (same dimensions) with no food inside, Participant 2 selected the box with the higher preference food on 80% of 60 trials, indicating the establishment of stimulus control using the black box. During the next 4 sessions, pictures of a less preferred food were gradually introduced on

the black box. Participant 2 selected the box with the higher preference food in 78% of 80 trials during these sessions. Participant 2 selected the less preferred food "prunes" on 72% of the 18 trials it was available. Thus, the use of prunes was discontinued, leaving only one less preferred food: "peach yogurt". During the next 9 sessions, pictures continued to be added to the box as the participant reached criteria at each level. Participant 2 selected a higher preference food on 77% of 175 trials. For the next 10 sessions an attending component was added to the procedure and Participant 2 continued to select the higher preference food on 78% of 214 trials. During the last 6 sessions of Phase F, the black box was covered on all sides with pictures of the less preferred food and fading steps involved shortening the boxes across four steps until the participant's only picture cue was the 2-dimensional picture that originally sat on the top of the box. During these sessions, Participant 2 selected the higher preference food on 95% of the first 102 trials and 100% of the final 40 trials using 2-dimensional pictures only. Thus Participant 2 met the mastery criterion of two consecutive training sessions with 80% correspondence or better. The probability of meeting this criterion by chance in one 20-trial session is approximately six in 1000.

Following the completion of training, two higher preference foods (strained carrots and strawberry-apple snack) and one lower preference food (peach yogurt), were used during follow-up probes. Participant 2's percent correspondence during the first two follow-up, within 3 days following training, was 100% on both occasions. The third and fourth follow-up assessments occurred 23 and 59 days after training and percent correspondence was 88% and 88%, respectively.

Participant 3's results are shown in the bottom graph of Figure 3. During 2-choice baseline assessment, Participant 3's percent correspondence was variable across the 13 sessions, but he averaged 75% across the last 4 sessions (24/32 trials). Across the eight 3-choice baseline sessions, Participant 3's percent correspondence averaged 64% (54/85 trials), with an average of 70% (49/70) across the last seven sessions. During 4-choice baseline assessments, Participant 3's percent correspondence averaged 38% (33/87 trials) across 8 sessions, with an average of 69% (11/16 trials) across the last two sessions. Training was not provided to this participant because of the improvement observed over time

Discussion

The original goal of this study was to empirically evaluate the acquisition of PECS Phases I through III for three nonspeaking adults with intellectual disabilities using a modified multiple-baseline design across participants. After baseline assessments, it was revealed that all three participants were able to perform the skills required for PECS Phases I and II, but not Phase III. Therefore, PECS Phase III became the focus of training.

The initial plan was to teach participants to select a desired item from an array of 4 pictures of preferred items and to exchange the selected picture with the corresponding item. However, the picture array was reduced from 4 to 2 because of the considerable training required to meet criterion with 2 pictures for Participants 1 and 2.

Participant 1 began training using a fading program which involved increasing the number of pictures from 2 to 4. However, she oscillated between 2 and 3 pictures and only reached 4 pictures during 1 session. The fading program was terminated after 38

sessions and 208 trials (Phases A and A1) and training focused on two pictures only with an attending component added. She met criterion with two pictures after 224 trials and showed maintenance during follow-up assessment.

Given the difficulty encountered by Participant 1 with 4 pictures, Participant 2 began training with 2 pictures only. The plan was to progress to 3 and then 4 pictures if Participant 2 could master 2 pictures fairly quickly. During baseline, Participant 2 performed near chance levels for 4-choice, 3-choice, and 2-choice assessments. The last two baseline sessions for 2-choice assessments, conducted after Participant 1 met mastery, were both at 50%. Initially during training (Phases A and B), Participant 2 continued to perform near chance level after 11 sessions (165 trials). The implementation of position fading, visible edibles, and direct response-reinforcement (Phases C, D, and E) resulted in a slight increase in performance, but Participant 2 did not meet criterion after 33 sessions (523 trials). Three major modifications were made to the procedures during training Phase F. First, direct response-reinforcement was used by covering the edibles with boxes (instead of the apparatus in Phase E) and requiring the participant to lift the box to retrieve the edible. Second, pictures were faded-in systematically to cover the boxes' surfaces. Lastly, the heights of the boxes were reduced until only pictures were presented. Participant 2 reached criterion with two pictures during this phase after 41 training sessions (818 trials).

During the first cluster of baseline assessments in Figure 3, Participant 3 performed near chance level for 4-choice, below chance level for 2-choice, and slightly above chance level for 3-choice assessments. Baseline assessments were repeated for Participant 3 after Participant 1 met criterion in 2-choice training. Participant 3's percent

correspondence improved substantially for 2- and 3-choice, reaching as high as 100% in one session each, while performance with 4 pictures remained near chance level. Baseline assessments were repeated after Participant 2 met criterion. Participant 3's percent correspondence for 2- and 3-choice assessments declined from the previous assessment, but still remained above chance levels. Training was not provided to Participant 3 given his baseline performance.

The results of this study suggest that the skills required for PECS Phase III may require extensive training for persons with severe intellectual disabilities. The picture exchange and selection of the corresponding item require a delayed picture-object quasi-identity conditional discrimination. Prior assessments of the participants showed that they have all passed ABLA Level 4, a simultaneous object-object quasi-identity conditional discrimination and failed Level 6, an auditory-visual discrimination. Recent research suggests that an object-object nonidentity conditional discrimination is more difficult than Level 4 and less difficult than Level 6 (Sakko, Martin, Vause, Martin, & Yu, 2004). Thus, it seems reasonable to assume that a picture-object quasi-identity conditional discrimination, required for PECS Phase III, may well be more difficult than Level 4. It is not clear whether the participants were able to perform object-object or picture-object nonidentity conditional discriminations. It is possible that Participants 1 and 2 were unable to do so and this may have contributed to the extensive training needed, whereas Participant 3 may have been able to perform these discriminations. In one study, Chambers and Rehfeldt (2003) successfully taught PECS Phases I through III using 4 pictures to 3 adults with mental retardation in the severe and profound range. The authors also reported that their participants were able to match 2-dimensional pictures to 3-

dimensional objects prior to training (quasi-identity conditional discriminations). Future research should examine whether participants with and without picture-object conditional discrimination would show different rates of acquisition for PECS Phase III. In the present study, it is possible that the difference in Participant 3's performance was related to his level of functioning. Participant 3 was diagnosed with moderate intellectual disability, whereas Participants 1 and 2 were both diagnosed with severe intellectual disability.

Although the present study addressed some of the methodological limitations in previous research by including baseline assessment and reliability checks on dependent measures and procedures, a major limitation of the present study is that the same training procedures were not applied to Participants 1 and 2, which was necessary due to a lack of progress. This essentially removed the replication across participants and limited the conclusion that the observed learning was a result of the training procedures. Furthermore, Participant 3 demonstrated improvement in discrimination skills during baseline assessments. Future research with additional participants is needed to establish the validity and generality of these training procedures.

Until further training research can shed light on PECS training, practitioners interested in teaching their clients to use PECS might consider two recommendations. First, it is highly desirable to determine the discrimination skills of the client using a direct assessment on various conditional discriminations such as object-object identity matching (e.g., passing ABLA Level 4), and object-object and picture-object quasi-identity matching. For example, one could adapt the ABLA Level 4 task by substituting 2-dimensional pictures for the 3-dimensional cube and cylinder. Second, if the client is

unable to perform object-object identity matching, it is highly improbable that the individual will learn PECS Phase III in a reasonable amount of time. It may be more profitable to focus first on teaching object-object identity matching.

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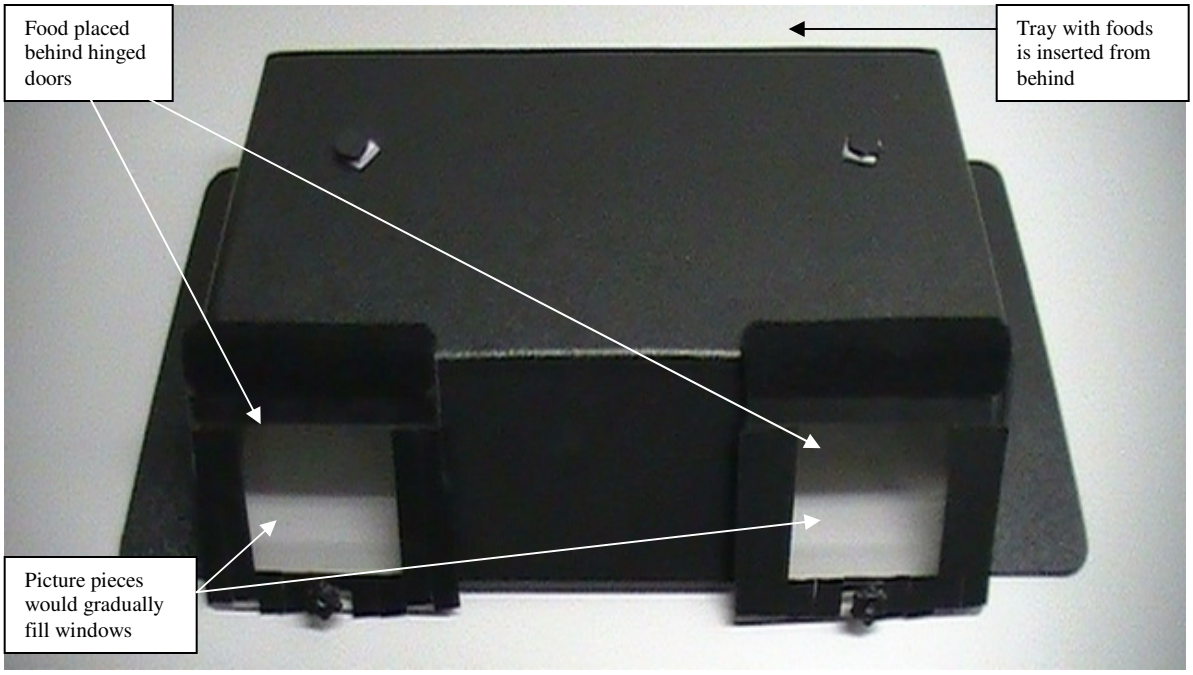

Figure 1. Apparatus used in discrimination training (Phase E) for Participant 2.

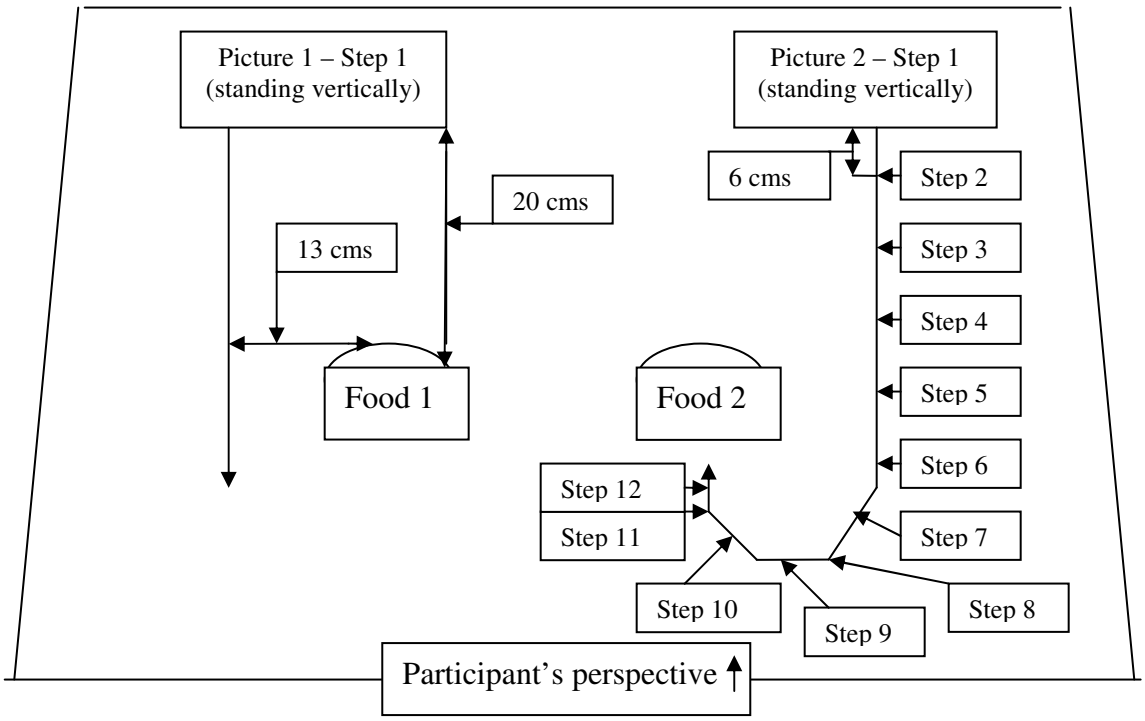

Figure 2. Illustration of procedure used in discrimination training (Phase F) for Participant 2.

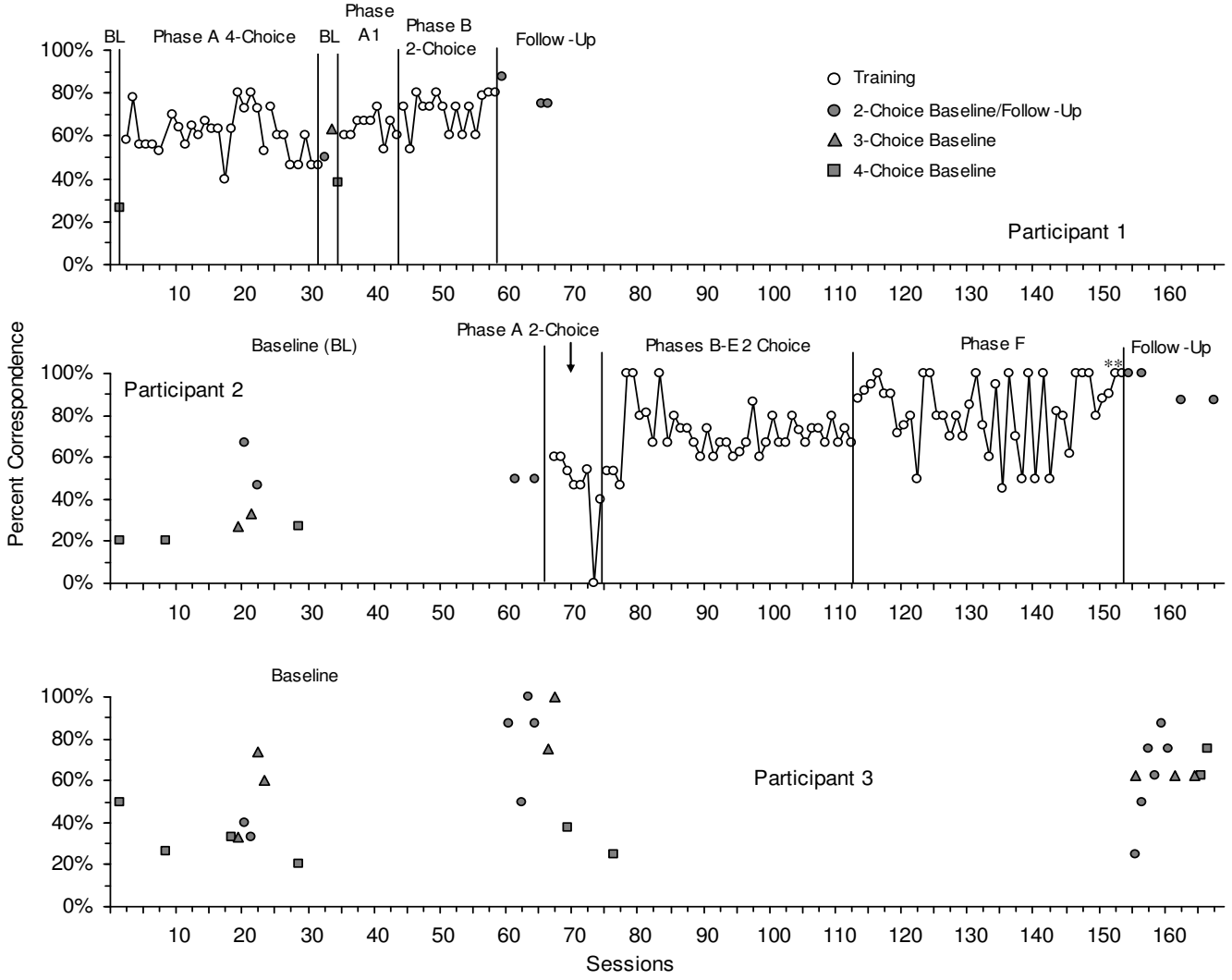

Figure 3. Percent of correspondence during baseline and training phases. Filled squares indicate baseline assessments involving 4 choices (pictures), filled triangles indicate baseline assessments involving 3 choices, and filled circles indicate baseline assessments involving 2 choices. Unfilled circles denote training data in the respective training phases. Asterisks above the last two data points in Phase F for Participant 2 reflect training sessions at the final fading step.

Appendix A: Baseline and Retention Assessment Procedural Reliability Data Sheet

BASELINE AND RETENTION ASSESSMENT - PROCEDURAL RELIABILITY
DATA SHEET

T1 = Trainer 1, who prompts and provides open palm	✓ = trainer(s) completed step correctly
T2 = Trainer 2, who provides phys assistance	X = trainer(s) completed step incorrectly
P = Participant	Note: use more than one ✓ or X per box if necessary

	Trial							
Trainer's Behaviours	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Binder is 3 m from P with 4 pics showing.								
2. T2 is located beside/behind P.								
3. T1 is 3 m from binder.								
4. Items are visible but out of reach of P								
5. T1 says "use the pictures to show me what you want" and extends open palm towards P								
6. P is given 10 s to initiate a response								
7. If P does not respond or performs a step incorrectly								
a. T2 physically assists P to complete incorrect step and								
b. P is given 10 s to initiate completion of the next step								
8. As soon as PIC has touched hand of T1,								
a. T1 says "Oh, you want (name of item)" and								
b. T1 gestures to P to take item from tray with 4 items.								
9. P is allowed to consume/play with item for 30s								

Appendix B: Two to Four Choice Discrimination Training Procedural Reliability Data

Sheet for Participant 1

2-4 CHOICE DISCRIMINATION TRAINING PROCEDURAL RELIABILITY DATA SHEET - PARTICIPANT 1

T = Trainer P = Participant	✓ = trainer(s) completed step correctly X = trainer(s) completed step incorrectly

	Trial														
Trainer's Behaviours	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1a. T selects pics using random table, T verbally prompts P to touch each picture presented at eye level (to establish attending behaviour).															
1b. T places 2 pics on table b/w P and T.															
2. T sits across from P, says "pick one", and provides 10s to respond. Prompt is repeated 1x at ~5s if P not attending.															
3a. T removes pics not selected and verbally prompts P to touch each object presented at eye level (to establish attending behaviour).															
3b. 2 objects (same # as in Step 1) are placed on table b/w P and T.															
4. T sits across from P, says "pick one", and provides 10s to respond. Prompt is repeated 1x at ~5s if P not attending.															
5a. If P touches/takes object that matches picture (CORRECT) P is allowed to either consume/play with item for 10 s.															
5b. If P touches/takes object that matches picture (CORRECT) T provides animated social praise, attention, and interaction for 10 s.															
6. If P attempts to take item (touches it) not matching pic (INCORRECT), T blocks P from taking item, says "no that's not it", ends trial, waits minimum 15 s, presents next trial.															
7. (IF APPLICABLE) The # of pic-object pairs presented on the next trial is increased following MASTERY, decreased following 3 cumulative errors, or is identical to last trial if increase/decrease criterion not met.															

Appendix C: Two Choice Discrimination Training Procedural Reliability Data Sheet for Participant 1

2-CHOICE DISCRIMINATION TRAINING
PROCEDURAL RELIABILITY DATA SHEET - PARTICIPANT 1

T = Trainer P = Participant	✓ = trainer(s) completed step correctly X = trainer(s) completed step incorrectly

	Trial														
Trainer's Behaviours	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1a. T selects pics using random table, T verbally prompts P to touch each picture presented at eye level (to establish attending behaviour).															
1b. T places 2 pics on table b/w P and T.															
2. T sits across from P, says "pick one", and provides 10s to respond. Prompt is repeated 1x at ~5s if P not attending.															
3a. T removes pics not selected and verbally prompts P to touch each object presented at eye level (to establish attending behaviour).															
3b. 2 objects (same # as in Step 1) are placed on table b/w P and T.															
4. T sits across from P, says "pick one", and provides 10s to respond. Prompt is repeated 1x at ~5s if P not attending.															
5a. If P touches/takes object that matches picture (CORRECT) P is allowed to either consume/play with item for 10 s.															
5b. If P touches/takes object that matches picture (CORRECT) T provides animated social praise, attention, and interaction for 10 s.															
6. If P attempts to take item (touches it) not matching pic (INCORRECT), T blocks P from taking item, says "no that's not it", ends trial, waits minimum 15 s, presents next trial.															
7. (IF APPLICABLE) The # of pic-object pairs presented on the next trial is increased following MASTERY, decreased following 3 cumulative errors, or is identical to last trial if increase/decrease criterion not met.															

Appendix D: Two Choice Discrimination Training Procedural Reliability Data Sheet for Participant 2 in Phase A

2-CHOICE DISCRIMINATION TRAINING
PROCEDURAL RELIABILITY DATA SHEET - PARTICIPANT 2 PHASE A

T = Trainer P = Participant	✓ = trainer(s) completed step correctly X = trainer(s) completed step incorrectly

	Trial														
Trainer's Behaviours	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1a. T selects pics from random, counterbalanced arrangement.															
1b. T places 2 pics on table b/w P and T.															
2. T sits across from P, says "pick one", and provides 10s to respond. Prompt is repeated 1x at ~5s if P not attending.															
3a. T removes pics not selected.															
3b. 2 objects (same as in Step 1) are placed on table (order haphazard) b/w P and T.															
4. T sits across from P, says "pick one", and provides 10s to respond. Prompt is repeated 1x at ~5s if P not attending.															
5a. If P touches/takes object that matches picture (CORRECT) P is allowed to consume item.															
5b. If P touches/takes object that matches picture (CORRECT) T provides social praise.															
6. If P attempts to take item (touches it) not matching pic (INCORRECT), T blocks P from taking item, says "no that's not it", ends trial, waits minimum 15 s, presents next trial.															

Appendix E: Two Choice Discrimination Training Procedural Reliability Data Sheet for Participant 2 in Phase C

2-CHOICE DISCRIMINATION TRAINING
PROCEDURAL RELIABILITY DATA SHEET - PARTICIPANT 2 PHASE C

Phase: Fading in "blank"

T = Trainer	✓ = trainer(s) completed step correctly
P = Participant	X = trainer(s) completed step incorrectly

	Trial														
Trainer's Behaviours	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1a. T selects 1 HP pic + BLANK and verbally prompts P to touch each picture presented at eye level (to establish attending behaviour). If necessary, a light physical prompt is provided after 2 verbal prompts and within ~10s. Verbal praise is provided after each pic is touched.															
1b. T places 1 HP pic and BLANK on table b/w P and T, using positions determined by CRITERIA.															
2. T sits across from P, says "pick one", and provides 10s to respond. Prompt is repeated 1x at ~5s if P not attending.															
3a. T removes pics not selected.															
3b. 2 objects (matching HI P and random LO P) are placed on table b/w P and T.															
4. T sits across from P, says "pick one", and provides 10s to respond. Prompt is repeated 1x at ~5s if P not attending.															
5a. If P touches/takes object that matches picture (CORRECT) P is allowed to either consume item.															
5b. If P touches/takes object that matches picture (CORRECT) T provides animated social praise.															
6. If P attempts to take item (touches it) not matching pic (INCORRECT), T blocks P from taking item, says "no that's not it", ends trial, waits minimum 15 s, presents next trial.															

Appendix F: Choice Discrimination Training Procedural Reliability Data Sheet for Participant 2 in Phase D

2-CHOICE DISCRIMINATION TRAINING
PROCEDURAL RELIABILITY DATA SHEET - PARTICIPANT 2 PHASE D

Phase: Fading in "LP", edibles in cup

T = Trainer	✓ = trainer(s) completed step correctly
P = Participant	X = trainer(s) completed step incorrectly

	Trial														
Trainer's Behaviours	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1a. T selects 1 HP pic + 1 LP pic and verbally prompts P to touch each picture presented at eye level (to establish attending behaviour). If necessary, a light physical prompt is provided after 2 verbal prompts and within ~10s. Verbal praise is provided after each pic is touched.															
1b. T places 1 HP pic and 1 LP on table b/w P and T, with matching food in cups placed on top of PICS at levels determined by CRITERIA.															
2. T sits across from P, says "pick one", and provides 10s to respond. Prompt is repeated 1x at ~5s if P not attending.															
3a. T removes pic/food not selected.															
3b. 2 foods (matching HP and LP) are placed on table b/w P and T.															
4. T sits across from P, says "pick one", and provides 10s to respond. Prompt is repeated 1x at ~5s if P not attending.															
5a. If P touches/takes food that matches picture (CORRECT) P is allowed to consume food.															
5b. If P touches/takes food that matches picture (CORRECT) T provides social praise.															
6. If P attempts to take item (touches it) not matching pic (INCORRECT), T blocks P from taking item, says "no that's not it", ends trial, waits minimum 15 s, presents next trial.															

Appendix G: Two Choice Discrimination Training Procedural Reliability Data Sheet for Participant 2 in Phase E

T = Trainer P = Participant	✓ = trainer(s) completed step correctly X = trainer(s) completed step incorrectly

	Trial														
Trainer's Behaviours	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1a. Apparatus is set up between T and P, minimum 7 inches from edge of table near P. Apparatus is centered in front of P.															
1b. Picture fading level is selected appropriately given CRITERIA and past responses.															
1c. i) T prompts (V+G) P to look at T. Repeats after 5s if nec. Provides phys prompt after 10s if nec.															
ii) After eye contact T prompts P to look at food on P's right, then left ("Ricky, look at this one" + point).Repeats for each step after 5s if nec. Provides phys prompt after 10s if nec.															
iii) If P attempts to touch a door T blocks and entire step is repeated after ~5s pause															
iv) If P resists phys prompt to look, entire step is restarted after ~5s pause.															
v) Again, T prompts (V+G) P to look at T. Repeats after 5s if nec. Provides phys prompt after 10s if nec.															
2. T selects 1 HP food and 1 LP food (or nothing depending on fading level), places the food(s) on a tray, inserts tray into apparatus, and verbally prompts P to "pick one".															
3a. If necessary, for trials with doors, each further prompt level is provided following 5s without progress towards touching an apparatus door or door knob.															
3b. If necessary, for trials without doors, "pick one" prompt is repeated at 5s if nec. Trial is ended if no response after 10s.															
4. T provides brief verbal praise following any selection and removes tray.															
5. If P opens the door P is allowed to consume the food item in that door.															

PROMPTING LEVELS to OPEN DOOR	
I	independent (no assist)
G	gestural prompt (pointing)
V	verbal prompt and gestural prompt
P	light physical prompt
F	full physical prompt

Note: Touching the knob or any other part of an apparatus door will be considered the P's selection.

Appendix H: Two Choice Discrimination Training Procedural Reliability Data Sheet for Participant 2 in Phase F

2-CHOICE DISCRIMINATION TRAINING
PROCEDURAL RELIABILITY DATA SHEET - PARTICIPANT 2 PHASE F

Phase: Fading in pictures WITH BOXES

T = Trainer P = Participant	✓ = trainer(s) completed step correctly X = trainer(s) completed step incorrectly

	Trial																			
Trainer's Behaviours	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
1. T presents tray with one HP BOX/FOOD and one LP BOX/NO FOOD (some sides may be black depending on fading level) on positions marked on tray and one spoon centered between P and foods, handle resting on lip of tray, pointing towards P.																				
2. T positions corresponding HP and LP pictures on the tray according to P's current PICTURE FADING LEVEL.																				
3. Still holding onto tray, T prompts P to look at each box/pic using verbal and gestural prompts until compliance.																				
4. T moves tray forward and instructs P to "pic.k one". After 5 s, if lack of progress, repeat the instruction. After 10 s end trial if no selection is made. PROVIDES NO ADDITIONAL PROMPTING																				
5a. CORRECT RESPONSE --> T provides brief verbal praise/SR+ following HP selection, allows P to consume a spoonful of food, and removes tray to end trial.																				
5b. INCORRECT RESPONSE --> T says nothing and removes tray to end trial.																				