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# EVALUATION OF THE PICTURE EXCHANGE COMMUNICATION SYSTEM

By

Anne Rena Cummings

A Thesis  
Submitted to the  
Faculty of The Graduate College  
In partial fulfillment of the  
Requirements for the  
Degree of Master of Arts  
Department of Psychology

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Anne Rena Cummings

# EVALUATION OF THE PICTURE EXCHANGE COMMUNICATION SYSTEM

Anne Rena Cummings, M.A.

Western Michigan University, 2002

The Picture Exchange Communication System (PECS) is a picture-based augmentative communication method that is widely accepted and utilized across children with a variety of disabilities. Despite its extensive dissemination, there is a dearth of empirically based support to document the effectiveness of PECS. The current study is the first to experimentally evaluate the effects of training during each of the 6 phases of PECS. Results indicated that with all 7 participants, the level of PECS responses consistently increased only after training was completed in Phases 1 through 4. In addition, all of the participants showed an increase in PECS responses during tests for Phases 5 and 6 as soon as training was completed in Phase 4. The current study also replicates and extends work by Bondy and Frost (1994) and Charlop-Christy, Carpenter, Le, LeBlanc, and Kellet (2002) in demonstrating that PECS can be trained in a short period of time and requires few, if any, pre-requisite skills. However, we did find that 3 of the 7 participants had difficulty with some aspects of training and, therefore, required further procedural modifications. The results of the current investigation are discussed in terms of a number of previously unsubstantiated claims regarding the benefit of PECS.

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## INTRODUCTION

In 1943, Leo Kanner published an article entitled “Autistic Disturbances of Affective Contact,” in which he described the syndrome of “early infantile autism.” The 11 children he described showed common signs of dramatic social withdrawal, communication disorders, rigidity for sameness in their environment, and a predominance of stereotypic behaviors. Since Kanner first described this disorder, the impairments in autism have been grouped into three areas of functioning, termed the “triad of impairment” by Wing and Gould (1979). This triad includes deficits in reciprocal social interaction, deficits in verbal and nonvocal communication, and a restricted repertoire of activities and interests. Communication deficits remain one of the core defining features of autism today (American Psychiatric Association, 2000).

The language characteristics of children diagnosed with autism generally fall into four general types of communication impairment (Mesibov, Adams, & Klinger, 1997). The first impairment is a general absence of spoken language. The second impairment involves an inability to converse with others, even though the child has the ability to speak. The third impairment refers to non-functional, repetitive language. Lastly, the fourth impairment is encompassed by a below-age level development of pretend, or socially interactive play skills (American Psychiatric Association, 2000).

Early figures estimated that approximately 50% of children diagnosed with autism were functionally mute, lacking “expressive” as well as “receptive” language (Charlop, 1983; Prizant, 1983; Rimland, 1964; Rutter, 1966, 1978). Currently, with

younger diagnosis and earlier intervention, data suggest that approximately 70% of the 50% of the children diagnosed with autism who are completely nonvocal can learn at least some expressive language if appropriate intervention procedures are begun before the age of five (Eisenberg & Kanner, 1956; Koegel & Kern Koegel, 1999; Rutter, 1968).

In the early 1960s, there was little known information about the etiology and treatment of autism. Psychoanalytic theories were still in existence when Ferster (1961) made a seminal connection between learning theory and autism. In his influential theoretical paper, Ferster suggested that the behavior of children with autism was maintained by operant variables (e.g., reinforcement) and could be controlled through “behavior modification” techniques. He stressed that the consequences for a child’s action were responsible for its occurrence. Further, he suggested that the key to reducing inappropriate behaviors was to discontinue consequences for the undesirable behavior. Moreover, Ferster and DeMeyer (1961) actually demonstrated that the same behavioral procedures used in the laboratory were successful in the day-to-day world of the child diagnosed with autism.

Ferster’s (1961) clearly presented and well-documented formulations eventually led to much valuable research corroborating the effectiveness of behavioral methods in the treatment of autism. However, Ferster’s suggestion that inattentive or depressed parents contributed to the etiology of the disorder by failing to reinforce behavior proved unfounded. Yet, because of Ferster’s contributions, Lovaas and his colleagues began a series of experiments that used various behavioral

procedures to change the behavior of children diagnosed with autism (Mesibov et al., 1997).

At a time when it is reported that many professionals blamed parents for their children's difficulties, Lovaas supported and educated parents by involving them in their children's treatment (Mesibov et al., 1997). Lovaas taught behavioral procedures to parents and viewed them as crucial members of the child's treatment team. Furthermore, Lovaas advocated the rejection of theories that lacked empirical support (Mesibov et al., 1997). His treatment methods (much like Ferster's) were developed in the laboratory and tested in the child's natural environment (e.g., Lovaas, Freitag, Gold, & Kassorla, 1965; Lovaas, Koegel, & Schreibman, 1979; Lovaas, Koegel, Simmons, & Long, 1973; Lovaas, & Schreibman, 1971; Lovaas, Schreibman, & Koegel, 1974). Lovaas' use of empiricism may have subsequently inspired other professionals to employ treatments that were based on data, rather than on untested theories derived from unfounded ideas about etiology (Mesibov et al.).

A seminal paper by Lovaas, Berberich, Perloff, and Schaeffer (1966) provided the first effective program for teaching vocal behavior to children diagnosed with autism. These investigators developed a series of systematic steps whereby the child's vocal responses were reinforced when they matched those of the therapist and were not reinforced if they did not. Once these imitation skills were established, they served as the building blocks for more complex language functions, such as semantics and syntax (e.g., Lovaas 1966, 1977, 1979; Risley & Wolf, 1967).

Early research (e.g., Carr & Durand, 1985; Charlop, 1983; Day, Horner, & O'Neill, 1994; Frea, Koegel, & Koegel, 1993; Koegel, & Koegel, 1990; Koegel,

Koegel, Hurley & Frea, 1992; Schreibman, & Carr, 1978) demonstrating effective linguistic treatment for children diagnosed with autism used the principles of reinforcement and punishment to eliminate inappropriate speech and replace it with appropriate speech. These operant training procedures focused primarily on teaching vocal imitation with the assumption that children learn to speak by attending to and repeating speech of others through shaping (Lovaas, 1977). In addition, a nonvocal child's attempts to communicate through nonvocal means were often viewed as disruptive or interfering and were eliminated before language teaching was implemented (Koegel, & Kern Koegel, 1999). Although this practice was successful with many children, some demonstrated vocal behavior that came under very restricted environmental control, which led to a general lack of spontaneity and generalization (Lovaas, 1977, 1979).

Researchers have used a variety of techniques to program the three types of generalization (stimulus, response, temporal). A few examples of these attempts include reducing the discriminability of reinforcement schedules (Koegel & Rincover, 1974; Rincover & Koegel, 1977), delaying the reinforcer (Dunlap, Koegel, Johnson, & O'Neill, 1987), teaching behaviors that are likely to be reinforced in the child's natural environment (Carr, 1980), teaching family members and teachers to provide ongoing intervention (O'Dell, 1974; Russo & Koegel, 1977), and fading items or people into the intervention setting (Koegel & Rincover, 1974).

The newer language intervention programs that evolved to help address the problems of generalization emphasized the reciprocal and interactive nature of communication and, therefore, accentuated the child's role as an active

communicative partner within a dyad. This represented a shift from the previous techniques that primarily focused on adult-initiated interactions and imitation. These more naturalistic techniques have been referred to as “milieu” teaching. Variations have been demonstrated with incidental teaching (Hart & Risley, 1968), the mand-model procedure (Warren, McQuarter, & Rogers-Warren, 1984), time delay (Halle, Marshal & Spradlin, 1979), natural language paradigm (Koegel, O’Dell & Koegel, 1987), and in-context teaching (Camarata & Nelson, 1992). These techniques focus on arranging the environment to increase children’s opportunities to use language, following the child’s choice/lead/interest, and using multiple naturally occurring examples to teach language.

From a behavioral perspective, Skinner (1957), suggested that we offset our tendencies to see words as units and look rather at their functions. For example, learning to name an object such as cup (i.e., a tact) has a different set of controlling variables and requires different conditioning than to ask for a cup (i.e., mand) when you are thirsty and need the cup to hold your water. The defining feature of Skinner’s verbal-behavior theory is the classification of verbal behavior by its function rather than its topography. From a Skinnerian perspective, language can be classified verbally or non-verbally through speech, gestures, the use of sign language, or by pointing/selecting a picture or word.

Spoken language is the most desired form of communication, and often the easiest for humans to acquire, as indicated by the quick acquisition of speech by most children in the absence of special training (Sundberg & Partington, 1998). Speech has many advantages, including: (a) a large speaking community that can model, prompt,

and reinforce vocal behavior, (b) portability, (c) its frequent pairing with strong reinforcers being delivered to the child (Sundberg & Partington). However, for many children with developmental disabilities, speech fails to develop, and may become difficult to establish at all. For these children, an alternative response form may be the most practical strategy. The three most common types of alternative or augmentative communication (AAC) are: (a) signing, (b) pointing to or exchanging pictures, and (c) writing or typing (Sundberg & Partington, 1998). Sign language is the most common of these, and has its own benefits. Sign language may be easier than speech training because many children who cannot imitate sounds or words can imitate motor responses. In addition, the motor behaviors involved in signing are often easier to train than vocal behavior because the trainer can physically prompt (and fade) the responses. Moreover, sign language and writing, like speech, can be categorized as a topography-based language (Michael, 1985). In this type of language, there is a different response topography (i.e., a different word or sign) for each controlling variable. This type of language system is contrasted with selection-based language systems such as PECS. In a selection-based language system, the response topography is the same (e.g., a pointing response), but the identified stimulus is different (Michael, 1985).

The importance and value of many types of communication cannot be stressed enough as communication deficits are correlated with numerous other social and behavioral problems (Schreibman, 1988). Therefore, for a small group of children who do not develop “expressive” vocal communication skills, AAC skills can still be

the focus of communication training. Non-speech communication is a legitimate goal in such cases (Prizant & Wetherby, 1989).

While many of the previously mute autistic children have been successfully trained in speech, it has been noted that their speech is not often “spontaneous”. Moreover, even with intensive intervention, some mute children remain without functional speech altogether (Rutter, 1966). This group of children has prompted researchers to explore the use of AAC. Although successes have been reported in which non-vocal children could effectively learn to communicate when using alternative systems such as sign language, whole-word communication boards, computerized devices, and picture/pictographic exchanges, the current literature documents few empirical studies.

Most programs that involve teaching speech, signs or picture systems, often teach labeling as the first communicative skill (Carr, 1982; Powers & Handleman, 1984). Skinner (1957), however, suggested a different strategy. In Skinner’s account of verbal behavior, labeling (tacting) is maintained by social reinforcers. Requesting (manding) is maintained by its specified consequences (i.e., receiving an apple after asking for an apple), rather than by socially based reinforcers. Therefore, labeling may not be the best first communicative step to teach children diagnosed with autism, because the type of reinforcement necessary to teach labels is either weak or non-existent (Frost & Bondy, 1994). Thus, Bondy and Frost suggest with the Picture Exchange Communication System (PECS; Bondy & Frost, 1994) that requesting should be the first communicative skill taught because it is maintained by specific,

concrete, and effective reinforcers. Therefore, it is suggested that this skill is likely to be learned more rapidly.

PECS has rapidly become one of the most widely utilized communication interventions available for nonvocal children with autism, and has been widely accepted by parents, educators, speech pathologists, behavior analysts, and other professionals (Bondy & Frost, 1994; Schwartz, Garfinkle, & Bauer, 1998). This behaviorally based system was developed as a strategy to establish communication with pictures, as according to the authors, the use of pictures can provide an immediate functional communication system. Bondy and Frost claim that PECS is a popular system because it: (a) provides children with a functional communication system that does not require any prerequisite behaviors, (b) is relatively simple, (c) is inexpensive to use, (d) is child initiated, (e) includes generalization strategies, and (f) may facilitate speech. These child-initiation and generalization components are considered to have an inherent appeal when choosing and evaluating non-vocal communication training packages and may account for the widespread use of PECS as an augmentative communication system (Schwartz et al.) According to Bondy and Frost, the exchange makes the child's approach more successful than simply having the child point to the picture, because the exchange: (a) does not involve prerequisite matching-to-sample skills, and (b) the children do not have difficulty obtaining the communicative partner's attention with the exchange. However, except for the minimal basic acquisition and speech outcome data presented by the originators of the system (Bondy & Frost), to date only two others studies have addressed the outcomes of PECS.

Schwartz et al. (1998) presented a program evaluation spanning a two-year period documenting the use of PECS for preschool children with developmental disabilities. The authors suggested that communication was improved quickly and efficiently via PECS and generalized to untrained settings. The data from their program evaluation suggested that while delivering PECS within a natural setting, 31 children with various disabilities were able to progress from having no functional communication skills to using PECS proficiently with both adults and peers within 14 months. This study, however, did not address the issue of vocal acquisition or the use of communicative functions other than requesting which were both claimed to be benefits of using PECS by Bondy and Frost (1994). Therefore, Schwartz et al. conducted a second study in which they examined these issues. The data from their second study suggested that (a) PECS use generalized across a variety of settings, (b) 44% of the children they followed acquired unprompted, non-echolalic vocal communication, and (c) children who were trained in PECS as a form of requesting also demonstrated increased use of different untrained communicative functions. Although their findings were consistent with the claims of Bondy and Frost in supporting the use of PECS as an augmentative communication system, one must keep in mind that their findings were based on a program evaluation rather than experimentation.

Charlop-Christy, Carpenter, Le, LeBlanc, and Kellet (2002) recently published the first experimental evaluation of PECS. Their three participants acquired PECS skills in a relatively short amount of training (i.e., less than 3 cumulative hours). In addition, a number of collateral behavior changes were

observed outside of the training session in generalization settings. All of the participants demonstrated an increase in spontaneous speech following PECS training. The authors also examined data for free-play sessions and illustrated that imitation and spontaneous speech were greatly improved from baseline scores to post-PECS-training scores. These data were also maintained at a one-year follow-up period. Data on the mean length of utterances also demonstrated an improvement for 2 of the 3 participants. In addition, the authors examined both social and inappropriate collateral behaviors. The authors found that social behaviors (which included requests and initiations, compliance, joint attention, interactive play, and eye contact) increased for all three participants, although the primary gains for each child were different. In general, there was also a reduction in inappropriate behaviors across all three children with the exception of one behavior (grabbing), which slightly increased for one participant. Although the authors presented a very well-controlled evaluation of PECS, their primary data consisted of performance in generalization settings. Thus, it is unknown how PECS responses were acquired across the various training phases or how such acquisition might be correlated with vocalizations or inappropriate behavior.

The outcomes of both of the above studies would suggest that PECS might be a viable augmentative communication system for children who have severe language impairments. However, given the numerous claims of the benefits associated with PECS it is important that we continue to add to the limited empirical research on this system. Therefore, the purpose of this study is to (a) contribute to the PECS literature by evaluating and demonstrating the utility of PECS by following the exact protocol

set forth by Bondy and Frost (1994) to teach children who have disabilities to use PECS, and (b) observe collateral behaviors such as (i) vocalizations and (ii) inappropriate behaviors that might be correlated with specific phases of PECS training.

## METHOD

### *Participants and Locations*

The participants in this study were seven children between the ages of 4 and 11 years. All participants attended an EMI (Educable Mentally Impaired) or PPI (Pre-Primary Impaired) classroom in an integrated school setting. All participants were recruited through regional school districts serving children with special needs.

Bob was 8-years old and was diagnosed with autism. He had limited vocal skills and was primarily echolalic. Using the Behavioral Language Assessment<sup>1</sup> (Sundberg & Partington, 1998), Bob's scores for each of the twelve items, along with an overall mean are displayed in table 2 (appendix B). The overall mean score for Bob was 3.9, indicating a more sophisticated verbal repertoire (see Table 2 and Appendix A). In addition, Bob had matching-to-sample skills (3 dimensions [3D] → 3 dimensions, 3 dimensions → 2 dimensions [2D], 2 dimensions → 2 dimensions) and passed Level 6 (combined auditory-visual conditional discriminations) on the Assessment of Basic Learning Abilities<sup>2</sup> (Kerr, Meyerson, & Flora, 1977).

Alex was 4-years old and was diagnosed with cerebral palsy and moderate- to severe-mental retardation. He had no vocal repertoire and his overall mean score was 1.5 on the Behavioral Language Assessment, indicating a generally limited verbal

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<sup>1</sup> The Behavioral Language Assessment is an informant assessment that contains 12 sections that assess a variety of basic language-related skills (e.g., cooperation, motor imitation, labeling, conversation). Each section is divided into 5 levels. Informants are asked to select a level that best represents the individual's repertoire in that area. In the current study, we averaged the level scores from all 12 sections for our final classification. Levels 1 and 5 are indicative of minimal and well-developed verbal repertoires, respectively.

<sup>2</sup> The Assessment of Basic Learning Abilities (formerly known as The Auditory-Visual Conditional Discrimination Test (AVC); (Kerr et al., 1977)), is a test of a hierarchy of six levels of visual and auditory discriminations that both typically developing and developmentally disabled children appear capable of making (Martin, & Yu, 2000). This test includes four levels of visual discriminations, (1) imitation, (2) position, (3) physical dimension, and (4) matching to sample; and two levels involving auditory discriminations, (5) simple auditory discriminations, and (6) auditory-visual conditional discriminations.

repertoire. In addition, Alex had limited matching-to-sample skills (3D → 3D only) and passed Level 4 (identity matching-to-sample) on the ABLA.

Sam was 4-years old and was diagnosed with Down Syndrome. He had limited vocal skills and his overall mean score was 1.5 on the Behavioral Language Assessment, indicating a generally limited verbal repertoire. In addition, Sam had matching-to-sample skills (3D → 3D, 3D → 2D, 2D → 2D) and passed Level 4 (identity matching-to-sample) on the ABLA.

Russell was 4-years old and was diagnosed with Down Syndrome. He had limited vocal skills and his overall mean score was 2.3 on the Behavioral Language Assessment, indicating a generally limited verbal repertoire. In addition, Russell had matching-to-sample skills (3D → 3D, 3D → 2D, 2D → 2D) and passed Level 6 (combined auditory-visual conditional discriminations) on the ABLA.

Dan was 11-years old and was diagnosed with autism and developmental delay. He had no vocal repertoire and his overall mean score was 2.1 on the Behavioral Language Assessment, indicating a generally limited verbal repertoire. In addition, Dan could not match to sample and passed Level 2 (matching to position) on the ABLA.

David was 10-years old and was diagnosed with autism. He had no vocal repertoire and his overall mean score was 2.3 on the Behavioral Language Assessment, indicating a generally limited verbal repertoire. In addition, David had matching-to-sample skills (3D → 3D, 3D → 2D, 2D → 2D) and passed Level 6 (combined auditory-visual conditional discriminations) on the ABLA.

Jeff was 8-years old and was diagnosed with severe apraxia. Although he had an advanced verbal repertoire, he had significant speech difficulties and spoke mainly in vowels. Jeff's overall mean score was 4.8 on the Behavioral Language Assessment, indicating a more sophisticated verbal repertoire. In addition, he had matching-to-sample skills (3D → 3D, 3D → 2D, 2D → 2D) and passed Level 6 (combined auditory-visual conditional discriminations) on the ABLA.

### *Setting and Materials*

All training sessions were conducted in separate rooms within each participant's school (typically an existing therapy room). Each room was approximately 10 feet by 12 feet, and contained a table, chairs, the PECS binder, icons, and programmed consequences that remained in plastic containers out of reach of the participant. A video camera was located in the room for session video taping. All testing sessions were conducted in a separate room containing the same furniture and materials.

The icons used in the current study were based on Mayer-Johnson (Johnson, 1994) symbols obtained from the Board Maker software program and photographs constructed according to specifications provided by Frost and Bondy (1994). All pictures/symbols were placed inside a plastic baseball cardholder. Velcro was attached to the backs of the cardholders for easy and secure placement both inside and on top of the communication binder. A 6 inch x 9 inch, 3-ring binder was used as the PECS communication board. The binder contained three strips of Velcro on the cover and on each page to secure the "I want" and "I see" sentence strips.

### *Dependent Variables and Data Collection*

The following dependent variables were assessed during both the training and testing phases.

*Exchanges.* Exchanges were defined for each phase as follows. Phase 1: the participant's behavior was scored for correctly exchanging the picture for the desired item with the trainer by independently releasing the picture into the trainer's hand. Phase 2: the participant's behavior was scored correct for taking only the picture of the desired item from the communication board and then exchanging the picture for the item with the trainer by independently releasing the picture into the trainer's hand. Phase 3: the participant's behavior was scored correct for taking only one from the array of pictures off of the communication board and then exchanging the picture for the desired item with the trainer by independently releasing the picture into the trainer's hand. Phase 4: the participant's behavior was scored as correct for placing the "I want" card and his chosen picture on the sentence strip and handing the entire strip to the trainer for exchange of the item. Phase 5: the participant's behavior was scored as correct, if in response to the trainer asking "What do you want?" the participant then placed the "I want" card plus his choice of pictures on the sentence strip, (in the correct sequential order), and then exchanging the sentence strip for the item by independently releasing the sentence strip into the trainer's hand. Phase 6: the participant's behavior was scored as correct if in response to the trainer asking "What do you see/want?" the participant then placed the appropriate "I see" card or "I want card plus his choice of pictures on the sentence strip, (in the correct sequential

order), and then exchanging the sentence strip for an item by independently releasing the sentence strip into the trainer's hand.

*Appropriate Vocalizations.* Each occurrence of an appropriate vocalization was scored for each participant. Appropriate vocalizations were defined as a meaningful and relevant/functional word or phrase uttered by the participant during a phase of training or testing. For example if Sam said "I want ball," or "I want," or simply "ball," when he saw the picture of the ball or the actual item, it was scored as a correct response. Appropriate vocalizations were scored predominantly for Sam, Russell, and Jeff, and one appropriate vocalization was scored for David immediately after training in Phase 3.

*Inappropriate Behaviors.* Each occurrence of an inappropriate behavior was scored for each participant. Dan's inappropriate behaviors were property destruction, aggression, and self-injury. Property destruction was defined as throwing, pushing, pulling, or breaking an object such as materials, the table, a chair, books, food etc. Aggression was defined as hitting, pinching, pushing or biting another person or object. Self-injury was defined as biting his own hand or other parts of his body, or banging a part of his body against another person or object. Bob's inappropriate behaviors were defined as yelling, screaming, crying and self-injury, such as hitting a part of his body with his hand or an inanimate object, or biting himself. All behaviors were carefully observed, but ignored for the extinction and training conditions. No behaviors met the frequency criterion for terminating a session. Termination criteria were: (a) if a participant showed signs of distress (for example, extensive crying), (b) if an accidental injury occurred, appropriate emergency measures would have been

taken and the session terminated, and (c) if four sessions in a row were terminated due to the participant's distress, he would have been excused from the study without any penalty. All exchanges, appropriate vocalizations and inappropriate behaviors were recorded using event recording.

### *Interobserver Agreement*

Interobserver agreement (IOA) was assessed for 68% of all testing sessions for all dependent variables. IOA was calculated using the point-by-point formula of agreements divided by agreements plus disagreements multiplied by 100% for exchanges. Bob's mean IOA score for exchanges was 96% (range, 88-100%). Alex, Russell and David's IOA for exchanges were 100%. Sam's mean IOA score for exchanges was 99% (range, 96-100). Dan's mean IOA score for exchanges was 92% (range, 88-100%). Jeff's mean IOA score for exchanges was 98% (range, 94-100%). For inappropriate behavior and vocalizations that were recorded using an event-recording system, the frequency-ratio formula (i.e., lower frequency divided by higher frequency multiplied by 100%) was used to calculate IOA. Bob's mean IOA score for inappropriate behaviors was 90% (range, 88-100). Dan's mean IOA score for inappropriate behaviors was 94% (range, 92-100). Sam's mean IOA score for appropriate vocalizations was 98% (range, 96-100). Russell's mean IOA score for appropriate vocalizations was 92% (range, 90-100). Jeff's mean IOA score for appropriate vocalizations was 90% (range, 88-100).

### *Experimental Design and Arrangement*

A minimum of three baseline "composite" testing sessions were conducted for each participant before PECS training was implemented. Baseline continued until

data were visually stable. Each testing session included a 2-minute “mini-session” designed to assess the highest level of responding for each PECS phase. Therefore, the initial testing sessions lasted for 12 min, plus set-up time. Testing sessions were conducted throughout the study after every two training sessions. Each PECS phase was trained until the participant performed 80% of the trials correctly for one or two consecutive training sessions. Once a testing “level” illustrated a stable and reliable increase for at least three consecutive sessions, it was no longer included in the composite testing session. For example, once criterion was met and maintained for PECS Phase one during the testing probes, it was no longer included in the composite session; only Phases 2 to 6 were assessed, for a total testing time of 10 min, plus set-up time. Testing session length was, therefore, reduced by 2 min as each PECS phase was mastered. All testing sessions were conducted in extinction (i.e., no programmed consequences were provided for target behaviors).

A within-subject design that employed multiple baseline (across behaviors) logic was used to demonstrate experimental control over the training protocol. The different tiers of the design consisted of the participants’ performance during each of the six composite test sessions. However, no treatment was applied to these behaviors in these sessions. Instead, a phase-change line was applied when training began in a specific phase in the separate training sessions. Experimental control was demonstrated when a specific phase’s behavior increased in the test sessions only when it had been taught in the corresponding training session. Although vocalizations and inappropriate behaviors were recorded during all sessions, they

were considered secondary dependent variables and were not used to determine phase changes.

### *Composite Testing Sessions*

*Phase 1.* A brief multiple-stimulus (without replacement) (MSWO) preference assessment was conducted before each Phase-1 test session. An assortment of objects (e.g., toys, edibles) was placed on a table in front of the participant. The first object pointed to or touched by the participant resulted in brief access or consumption before it was removed. This process continued until three items were selected by the participant. The trainer then removed all items and began the test session. The preferred item and its corresponding picture card were placed on the table between the trainer and the participant. Both were available during a free-operant condition to determine whether the participant would attempt to exchange the picture for the item. A correct response was scored if the participant independently picked up the picture and handed it to the trainer. The trainer would then receive the picture and replace it on the table without exchanging the picture for the item.

*Phase 2.* The Phase-2 test session began with the brief MSWO assessment as described for Phase 1. The trainer then placed the picture of the preferred item on the communication binder (only this picture was placed on the binder). A correct response was scored if the participant independently removed the picture from the binder and handed it to the trainer. The trainer would then receive the picture and replace it on the communication binder without exchanging the picture for the item.

*Phase 3.* During the Phase-3 test session, the trainer initially implemented an MSWO assessment in order to obtain the top 5 reinforcers for the session. The trainer

then placed 2 to 5 pictures on the communication binder. A correct response was scored if the participant independently removed the picture from the binder and handed it to the trainer. The trainer would then receive the picture and replace it on the binder without exchanging the picture for the item.

*Phase 4.* During the Phase-4 test session, a variety of preferred items as determined by an MSWO assessment were placed on the table next to the trainer. A correct response was scored if the participant independently removed the “I want” card from the binder and placed it on the sentence strip, removed the picture from the binder and placed it on the sentence strip (next to the “I want” card), and then removed the entire sentence strip and handed it to the trainer. The trainer would then receive the sentence strip and replace its various components in their correct positions on the binder without exchanging the picture for the item.

*Phase 5.* During the Phase-5 test session, one preferred object as determined by an MSWO assessment was placed on the table next to the trainer and the “I want” card and five pictures of preferred items were placed on the communication binder. The trainer asked the participant “What do you want?” every 30 s. The trials were scored as correct if when after this question was asked, the participant independently removed the “I want” card from the binder and placed it on the sentence strip, removed the picture from the binder and placed it on the sentence strip (next to the “I want” card), and then removed the entire sentence strip and handed it to the trainer. The trainer would then receive the sentence strip and replace its various components in their correct positions on the binder without exchanging the picture for the item.

*Phase 6.* During the Phase-6 test session, a variety of pictures of preferred and non-preferred items as determined by an MSWO assessment were placed on the binder with the sentence strip, an “I want” card, and an “I see card.” Every 30 s, the trainer would hold up an item and ask the participant either “What do you want?” or “What do you see?” Two trials of each question were assessed during each 2-min test phase. The trials were scored as correct if when the trainer asked the question, the participant independently removed the appropriate card (“I want” or “I see”) from the binder, placed it on the sentence strip, removed the picture from the binder and placed it on the sentence strip (next to the “I want/see” card), and then removed the entire sentence strip and handed it to the trainer. The trainer would then receive the sentence strip and replace its various components in their correct positions on the binder without exchanging the picture for the item.

### *Training Procedures*

PECS training consisted of the following six phases (and 15 sub-phases).

*Phase 1 – Teaching the Picture Exchange.* The goal of this phase was to train the participants to exchange the picture of an item for its referent. During the first sub-phase, the trainer identified preferred items by implementing an MSWO assessment. An array of eight objects (e.g., toys, edibles) was placed on a table in front of the participant, and the first object pointed to or touched by the child was selected as the “preferred item.” This item was then taken out of the array and the remaining items were shuffled and represented. This continued until three items had been selected by the participant. The trainer then removed all the items and represented the one that was first chosen. When the participant tried to reach for the

preferred object, the trainer placed its picture into his hand. While the participant held the picture, the trainer gently guided (physically) him to release the picture into the trainer's opened hand. As soon as the picture was released, the trainer said, "You want \_\_\_\_," and showed the participant the item with the picture. The participant was then given the item. The next sub-phases included fading out all assistance until the participant independently picked up the picture and placed it into the trainer's open hand. This phase was completed and the next phase was begun when the participant correctly and independently performed 80% of the trials for two consecutive sessions.

*Phase 2 – Spontaneity.* An MSWO assessment was implemented for each participant as

described for Phase 1 above. The goal of this phase was to teach participants to go to their communication board, select the picture of the preferred item, reach for the trainer, and release the picture into his/her hand. The trainer placed the picture of the preferred item on the communication binder (only this picture was located there). In the beginning, the participant was taught, with some assistance, to remove the picture from the board, reach for, and place the picture into the trainer's open hand to receive the requested item. In the next sub-phase, the distance between the trainer and the child was gradually increased. Initially, the trainer stepped three feet away from the participant, requiring him to walk towards the trainer to hand over the picture.

During the next sub-phase, the distance between the participant and the communication board was increased by three feet, requiring the participant to walk to the communication board and then to the trainer to complete the exchange. This phase

was completed and the next phase was begun when the participant correctly and independently performed 80% of the trials for two consecutive sessions.

*Phase 3 – Picture Discrimination.* The goal of this phase was to teach participants to distinguish among different pictures. First, the trainer placed two pictures on the communication board: one of a preferred item and a blank card. If the participant removed the picture of the preferred item and handed it to the trainer, the item was delivered. If the participant tried to remove the blank card, the trainer redirected him to the picture of the preferred item by gently moving his arm to the picture. The next sub-phases included replacing the blank card with a picture of a less preferred item and gradually adding more pictures of items (up to five). Initially, these pictures were of non-preferred items. The pictures then increased with regard to their degree of preference until all pictures were of equal (high) preference. This phase was completed and the next phase was begun when the participant correctly and independently performed 80% of the trials with all of the pictures for two consecutive sessions.

*Phase 4 – Sentence Structure.* The goal of this phase was to teach participants to request items by creating sentence strips. As the first step, the trainer included a card with the phrase “I want” on the sentence strip, which was located on the top of the communication board. A variety of preferred items as determined by an MSWO were available at a table next to the trainer. Whenever the participant attempted to remove one of the pictures from the communication board, the trainer physically guided him to place the chosen picture on the sentence strip to the right of the “I

want” card. The participant was then guided to hand the strip to the trainer to receive the item. The next sub-phase included teaching the participant to place the “I want card” on the sentence strip and then place the picture of the preferred item next to the “I want” card. This phase was completed and the next phase was begun when the participant correctly and independently performed 80% of the trials for two consecutive sessions.

*Phase 5 – Responding to “What Do You Want”?* Training began with one preferred object located on a table next to the trainer and the “I want” card plus five pictures of preferred items on the communication board. The trainer simultaneously pointed to the “I want card” and said, “What do you want?” During the phase, the time between the question and pointing to the “I want” card was gradually increased. This step was considered completed when the participant was able to pick up the “I want” card before the trainer pointed to it. The next sub-phase included opportunities to use the “I want” card when asked, “What do you want?” and to spontaneously request. This phase was completed and the next phase was begun when the participant correctly and independently performed 80% of the trials (i.e., answered the questions) for two consecutive sessions.

*Phase 6 – Responding to “What Do You See”?* During this phase, the communication board included an “I see” card and pictures of various preferred items. The trainer held an item and asked the question “What do you see?” while pointing to the “I see” card. If necessary, the participant was guided to pick up the “I see” card and the appropriate picture. Correct responses were not rewarded with the delivery of the item, but with another high-preference reward, as determined by the

MSWO (e.g., a toy, a candy) because we were teaching tacts. The next sub-phase consisted of interspersing the question “What do you see?” with “What do you want?” This phase was completed and when the participant correctly and independently performed 80% of the trials (i.e., answered the questions) for two consecutive sessions.

### *Modifications.*

During Phase-6 training, it became apparent that some procedural modifications needed to be made for participants 1, 2, and 5 to learn the discriminations. All three participants required an additional step of an extra-stimulus color prompt to discriminate between the “I want” and the “I see” cards. The “I want icon” was printed on a white background and the “I see” icon was printed on a blue background. Similarly, the sentence strip had either a white or blue background depending on what question was being asked by the trainer. These color prompts were faded by making the blue color less vibrant, until the participant could independently respond with both sides of the strip being white in color.

In addition, participant 5, Dan had difficulty physically accessing the pictures/icons and removing the sentence strip. This was solved by changing the picture cover from a flexible plastic baseball cardholder to an inflexible Plexiglas picture frame (2” x 3”). Similarly, the cardboard sentence strip holder was changed to an inflexible Plexiglas picture frame (3” x 9”) that was placed on the communication binder at a 45-degree angle, thereby making it easier for him to grasp and remove.

Dan had difficulties ordering the cards/pictures in the correct sequence (placing the “I want/I see” cards before, [to the left of], the pictures) in phases 4, 5, and 6. Therefore, he was taught to use both hands to remove the “I want” or “I see” card simultaneously with the icon (one in each hand) and put them both on the sentence strip at the same time.

Finally, participant 7, Jeff was provided only verbal instructions for each training phase due to his typical intellectual functioning. He was able to complete the highest sub-phase (at 100%) within each phase after one verbal instruction was provided. Jeff was diagnosed with severe apraxia and, therefore, he spoke mainly in vowels. For example, he would say “oeo ooie” for “oreo cookie.” Although Jeff was typically developing, he attended an EMI classroom and therefore, his listeners had great difficulty understanding his vocal repertoire. Thus, for Jeff PECS would be especially relevant for his listeners.

### *Treatment Integrity*

Treatment integrity measures were calculated for 98% (23/24) of Bob’s training sessions, 92% (47/51) of Alex’s training sessions, 94% (28/30) of Sam’s training sessions, 89% (16/18) of Russell’s training sessions, 99% (51/52) of Dan’s training sessions, 96% (13/14) of David’s training sessions, and 100% (12/12) of Jeff’s training sessions. Treatment integrity measures were not calculated during testing phases.

*Phase 1.* The trainer’s behavior was scored for correctly exchanging the desired item with the participant contingent on the participant’s independent release of the picture into the trainer’s hand. Treatment integrity was calculated by dividing

the number of times the trainer made a correct exchange by the total number of exchanges. Mean treatment-integrity scores for Phase 1 were 92%, 95%, 100%, 100%, 88%, 100%, and 100% for Bob, Alex, Sam, Russell, Dan, David, and Jeff, respectively.

*Phase 2.* The trainer's behavior was scored correct for placing only the picture of the desired item on the communication board and then for exchanging the desired item with the participant contingent on the participant's independent release of the picture into the trainer's hand. Treatment integrity was calculated by dividing the number of times the trainer made a correct exchange by the total number of exchanges. Mean treatment-integrity scores for Phase 2 were 95%, 100%, 100%, 100%, 94%, 100%, and 100% for Bob, Alex, Sam, Russell, Dan, David, and Jeff, respectively.

*Phase 3.* The trainer's behavior was scored correct for placing 2 to 5 pictures on the communication board and then for exchanging the desired item with the participant contingent on the participant's independent release of the picture into the trainer's hand. Treatment integrity was calculated by dividing the number of times the trainer made a correct exchange by the total number of exchanges. Mean treatment-integrity scores for Phase 3 were 100%, 100%, 100%, 100%, 93%, 100%, and 100% for Bob, Alex, Sam, Russell, Dan, David, and Jeff, respectively.

*Phase 4.* The trainer's behavior was scored as correct for placing the "I want" sentence strip in the correct position on the communication board and then for guiding (if necessary) the participant to place his chosen picture next to the sentence strip and handing the entire strip to the trainer for exchange of the item. Treatment

integrity was calculated by dividing the number of times the trainer made a correct exchange by the total number of exchanges. Mean treatment-integrity scores for Phase 4 were 97%, 95%, 100%, 100%, 89%, 100%, and 100% for Bob, Alex, Sam, Russell, Dan, David, and Jeff, respectively.

*Phase 5.* The trainer's behavior was scored as correct for pointing (if necessary) to the "I want" sentence strip while simultaneously asking the participant "What do you want?" Treatment integrity was calculated by dividing the number of times the trainer asked the participant what he wanted and exchanged the item by the total number of exchanges (correct plus incorrect asking). Mean treatment-integrity scores for Phase 5 were 100% for all 7 participants.

*Phase 6.* The trainer's behavior was scored as correct for pointing (if necessary) to the "I see" or "I want" sentence strip while simultaneously asking the participant "What do you see/want?" Treatment integrity was calculated by dividing the number of times the trainer asked the participant what they wanted/saw and then exchanged the items by the total number of times the trainer exchanged the items (correct plus incorrect asking). Mean treatment-integrity scores for Phase 6 were 100% for all 7 participants.

## RESULTS

### *Participant Assessments*

As seen in Table 1 (Appendix A), Bob, Sam, Russ, David, and Jeff, displayed matching-to-sample skills for all three levels of the assessment (3D → 3D, 3D → 2D; 2D → 2D). Alex was able to demonstrate 3D → 3D matching to sample, but not 3D → 2D or 2D → 2D matching to sample. Dan was not able to demonstrate any matching-to-sample skills. Table 1 also indicates that Bob, Russ, David, and Jeff achieved Level 6 (combined auditory-visual discrimination) on the ABLA. Additionally, Alex and Sam achieved Level 4 (visual matching-to-sample) and Dan achieved Level 2 (position discrimination). The scores for each participant's Behavioral Language Assessment are displayed in Table 2. Scores are provided for each of the 12 items along with an overall mean. The means for Alex, Sam, Russ, Dan, and David were close to Level 2, indicating a limited verbal repertoire. Bob's and Jeff's means were higher (3.9 and 4.8, respectively) indicating a more advanced verbal repertoire. With the exception of Dan and Jeff, all of the participants had extensive ranges (1 to 5) across the items.

### *Evaluation of PECS*

*Test-session PECS data.* Graphs of each participant's training data are illustrated in Appendices B through H. Figures 1 through 7 illustrate the primary data from the composite-testing sessions. As seen in these figures, a consistent pattern emerged for all participants. The level of PECS responses consistently increased only after training was completed in Phases 1 through 4. In addition, all of the participants

showed an increase in PECS responses during composite-testing sessions for Phases 5 and 6 as soon as training was completed in Phase 4. Similarly, an increase in PECS responses was observed during composite-testing sessions for Phase 6 when training was complete in Phase 5.

*Appropriate Vocalizations.* Figures 1 through 7 (Appendices D through J), also display appropriate vocalizations that occurred during composite-testing sessions for each participant. Bob, Alex, David, and Dan did not exhibit any appropriate vocalizations before or after PECS training during any of the composite-testing sessions. However, Sam, Russell, and Jeff exhibited increased levels of appropriate vocalization during each phase following training. These data are summarized in Figure 10 (Appendix M). Sam's percentage increase in vocalizations ranged from 280 percent in Phase 2 to 730 percent in Phase 4. Russell's percentage increase in vocalizations ranged from 400 percent in Phase 1 to 2570 percent in Phase 3. Jeff, however, was unique to our participant group in that he was already quite vocally sophisticated. Jeff was diagnosed with severe apraxia and, although he was quite vocal at the onset of the study, he spoke mostly in vowels that were difficult to comprehend. Jeff's percentage increase in vocalizations ranged from 103 % in Phase 4 to 370 percent in Phase 2. Overall, three of our participants exhibited more appropriate vocalizations following training in each PECS phase compared to before.

*Inappropriate Behavior.* Figures 8 and 9 (Appendices K and L), display inappropriate behaviors that occurred during composite-testing sessions for Bob and Dan, who were the only participants to exhibit inappropriate behavior during the

study. Although Bob's inappropriate behaviors were consistently low throughout the study and Dan's were somewhat higher and more variable, there were some phase-specific differences for each participant. Bob's inappropriate behavior increased slightly after training in Phases 1 and 3, remained the same after training in Phases 2 and 5, and decreased after training in Phases 5 and 6. Dan's inappropriate behavior increased slightly after training in Phases 2 and 3, remained the same after training in Phases 1, 4, and 6, and decreased after training in Phase 5. The percentage change of Bob's and Dan's inappropriate behaviors per PECS phase are summarized in Figure 11 (Appendix N). Overall, there were no reliable reductions in inappropriate behavior due to PECS training.

## DISCUSSION

Despite the widespread dissemination of PECS, the current study is the first to experimentally evaluate the effects of training during each of the 6 phases of the PECS protocol. In the present study, seven children between the ages of 4 and 11 years, who all attended EMI (Educable Mentally Impaired) or PPI (Pre-Primary Impaired) classrooms in an integrated school setting were taught to use PECS. For all participants, the frequency of Phase 1-4 responses consistently increased only after training was completed in each respective phase. However, all participants showed an increase in Phase 5-6 responses as soon as training was completed in Phase 4. In other words, although there appeared to be a relation between certain phases *within* the protocol, all participants were able to complete the protocol.

The current study modestly contributes to the literature by demonstrating the generality of PECS across participants with a variety of clinical characteristics. Charlop-Christy et al. (2002) reported the successful use of PECS with children who had been diagnosed with autism. In addition, the program evaluation reported by Schwartz et al. (1998) included children who had been diagnosed with autism, Down syndrome, Pervasive Developmental Disorder Not Otherwise Specified (PDD NOS), Angleman's syndrome, and other developmental disabilities. The current study was the first to *experimentally* evaluate PECS across a variety of populations, including autism, mental retardation, Down syndrome, and apraxia.

One of the chief contributions of the current investigation is that a number of previously unsubstantiated claims regarding PECS training were evaluated. One of

the common claims regarding PECS (Bondy & Frost, 1993) is that all six phases of PECS can be trained in a relatively short period of time. In concordance with findings reported by Charlop-Christy et al. (2002), all participants in the current study progressed through the PECS protocol relatively quickly. As indicated in Table 3 (Appendix C) and Appendices D through J, all of the participants were able to master all phases of PECS training in less than 52 training sessions (i.e., 520 minutes). Another claim made regarding PECS (Bondy & Frost, 1994) is that the protocol requires no prerequisite skills. Although all of the participants in our study were able to complete the protocol, 3 of the 7 participants had some difficulty with training and, therefore, required procedural modifications before mastery was obtained.

Interestingly, those participants who progressed through PECS training the quickest without additional modifications scored the highest on both of the participant assessments. For example, Table 1 indicates that Bob, Russ, David, and Jeff achieved Level 6 (combined auditory-visual discrimination) on the ABLA. Likewise, these four participants were able to complete all levels of the matching-to-sample assessment without any difficulties. Bob, Russell, David, and Jeff completed all 6 phases of PECS training in 240, 180, 140, and 120 minutes, respectively. By contrast, Alex, Sam, and Dan, all of whom had some difficulty on the matching-to-sample or ABLA assessments, required the most time to complete training (510, 300, and 520 minutes, respectively). Dan, in particular, had difficulties with PECS training from Phases 3-6 and required several modifications at each phase before completing the protocol. Moreover, Dan was the only participant who was unable to complete any

level of the matching-to-sample assessment. Furthermore, Dan was not able to pass beyond level 2 (position discrimination) on the ABLA assessment.

Given that PECS is a visual system that logically would seem to require a fairly sophisticated repertoire of non-identity matching-to-sample, simple assessments of matching-to-sample or use of the ABLA may provide the trainer with predictive information on the learner. The ABLA assesses four levels of visual discrimination skills, one level of auditory discrimination skills, and one level of auditory-visual combined discrimination skills. It has been reliably demonstrated that this six-level hierarchy holds constant for various populations (Casey & Kerr, 1977; Vause, Martin, & Yu, 2000). Because this hierarchy is progressive, it follows that one would need to be able to make visual discriminations before auditory discriminations, and auditory discriminations before auditory-visual combined discriminations. Therefore, individuals who fail Level 4 of the ABLA should have difficulty learning certain visual and auditory discriminations required in PECS training (as did Dan). PECS involves exchanging a 2D visual stimulus (a card) for a 3D visual stimulus (an actual item). According to the ABLA hierarchy of skills, this non-identity, visual-visual matching-to-sample skill requires less effort for a person to acquire than would an auditory skill or an audio-visual combined discrimination skill (Harapiak, Martin, & Yu, 1999). However, the non-identity matching (3D-2D) skill required for the appropriate exchange in PECS is still a more complex skill than identity matching (3D-3D) which is required for Level 4 of the ABLA (Cummings & Williams, 2000). All of the participants in the current study completed the protocol (albeit with modifications for some). Therefore, the claim that PECS requires no pre-requisite

skills was actually supported. Our data suggest that, although PECS might require no prerequisite skills for mastery, certain skills might facilitate progression through the protocol. Further, trainers may be required to be especially proficient in modifying interventions in cases in which certain assessments (e.g., ABLA) identify difficulties in skills taught during PECS.

Another published claim regarding PECS is that it results in increases in appropriate vocalizations and decreases in inappropriate behaviors (Bondy & Frost, 1994; Peterson, Bondy, Vincent & Finnegan, 1995; Schwartz, Garfinkle, & Bauer, 1998). These claims were recently empirically demonstrated by Charlop-Christy et al. (2002). Both of these behavior classes were also tracked in the current study. Although Bob, Alex, David, and Dan did not exhibit any appropriate vocalizations before or after PECS training during the composite-testing sessions, Sam, Russell, and Jeff exhibited increased levels of appropriate vocalization during each phase following training. This finding partially supports some of the claims made regarding PECS, as well as the findings of Charlop-Christy et al. However, there are at least two reasons why more reliable increases in vocal behavior were not found. First, the main focus of the current study was to simply evaluate PECS. As a result, our primary dependent variables were evaluated in brief extinction conditions immediately before and after training. One might not expect such an environment to facilitate or maintain vocal behavior. Further, much of the vocal behavior that increased following PECS training was comprised primarily of requests for Sam, Russell and Jeff, and few words/phrases signaling their frustration for Sam and Russell. Second, it is likely that the proposed link between PECS and vocalizations

requires specific mediating conditions (e.g., reinforcement) in the natural environment.

The only inappropriate behaviors that occurred during the composite-testing sessions were seen with Bob and Dan. Bob's inappropriate behaviors occurred at consistently low levels throughout the study and Dan's were somewhat higher and more variable. However, there were no phase-specific differences and, more importantly, no reliable reductions after PECS training in each phase. There are at least three reasons why we failed to substantiate the proposed link between PECS and reductions of inappropriate behavior. First, the link might not be inherently reliable. Second, only two of our participants engaged in inappropriate behavior to begin with. Finally, the most likely explanation for such a relation would be that specific reinforcers earned during PECS exchanges substitute for or compete with reinforcers for inappropriate behavior. Given our testing model, this more long-term phenomenon would not be observable.

A few limitations of the current study should be discussed. First, long-term data on the effects of PECS training were not collected. Because the study was designed to evaluate training during each PECS phase, the long-term effects on other repertoires (e.g., vocalizations) could not be evaluated. A pre-post assessment in the natural environment would be one way to evaluate such PECS-related changes (Charlop-Christy et al., 2002). In addition, the use of a multiple-baseline design across PECS phases resulted in a few minor problems. Because the progression through PECS phases was driven by participant data, the amount of time between the

post-intervention period of one phase and the subsequent pre-intervention period of the subsequent phase was sometimes rather brief.

In conclusion, the current study provides some of the first experimental evidence to evaluate claims of PECS and, most importantly, to demonstrate the function of each PECS phase. The current study showed that PECS could be trained in a relatively brief period of time, with children who had a variety of diagnostic conditions, without any specific prerequisite skills. In addition, data from the current study which were produced using an extinction-based evaluation, suggest the possibility of reconfiguring the PECS training structure. Phase 4 and 5 essentially teach different forms of the same mand response. Those responses are then incorporated into Phase 6 and constitute 50% of its trials. It might be possible to somehow consolidate the mand training that occurs across Phases 4-6 to produce a more efficient protocol. In addition, it might be possible to train Phases 1-3 and then skip to Phase 6 for certain learners. Further analysis of the PECS phase hierarchy is necessary to answer this question; however, the demonstrated relation between Phases 4, 5, and 6 remains interesting.

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## Appendices

## Appendix A:

Table 1

*Summary Data for Matching to Sample and ABLA Assessments*

| Participant | Matching to Sample |       |       | ABLA  |
|-------------|--------------------|-------|-------|-------|
|             | 3D-3D              | 3D-2D | 2D-2D | Level |
| Bob         | YES                | YES   | YES   | 6     |
| Alex        | YES                | NO    | NO    | 4     |
| Sam         | YES                | YES   | YES   | 4     |
| Russell     | YES                | YES   | YES   | 6     |
| Dan         | NO                 | NO    | NO    | 2     |
| David       | YES                | YES   | YES   | 6     |
| Jeff        | YES                | YES   | YES   | 6     |

Table 2

Appendix B:

*Summary Data for The Behavioral Language Assessment*

|             |             | Request | Motor     | Vocal | Vocal     | Match to |           | Label  | Receptive | Coversation   | Letters & | Social      |      |
|-------------|-------------|---------|-----------|-------|-----------|----------|-----------|--------|-----------|---------------|-----------|-------------|------|
| Participant | Cooperation | (Mand)  | Imitation | Play  | Imitation | Sample   | Receptive | (Tact) | by FFC    | (Intraverbal) | Numbers   | Interaction | Avg. |
| Bob         | 2           | 2       | 5         | 5     | 4         | 5        | 5         | 2      | 1         | 5             | 5         | 2           | 3.6  |
| Alex        | 2           | 2       | 1         | 1     | 1         | 1        | 4         | 1      | 1         | 1             | 1         | 2           | 1.5  |
| Sam         | 2           | 3       | 2         | 2     | 2         | 4        | 5         | 2      | 2         | 2             | 2         | 1           | 2.4  |
| Russell     | 2           | 1       | 3         | 4     | 2         | 2        | 4         | 2      | 2         | 2             | 2         | 1           | 2.3  |
| Dan         | 3           | 2       | 2         | 2     | 1         | 2        | 3         | 3      | 2         | 1             | 1         | 3           | 2.1  |
| David       | 5           | 2       | 2         | 1     | 1         | 5        | 3         | 1      | 3         | 1             | 1         | 2           | 2.3  |
| Jeff        | 5           | 5       | 5         | 4     | 4         | 5        | 5         | 5      | 5         | 5             | 5         | 5           | 4.8  |

## Appendix C:

Table 3

*Number of Sessions for and Duration of PECS Training*

| Participant | Training Phases (# of Sessions) |   |    |    |    |    | Total     | Total      |
|-------------|---------------------------------|---|----|----|----|----|-----------|------------|
|             | 1                               | 2 | 3  | 4  | 5  | 6  | Sessions  | Minutes    |
| Bob         | 3                               | 3 | 2  | 2  | 2  | 12 | <b>24</b> | <b>240</b> |
| Alex        | 2                               | 8 | 11 | 5  | 7  | 18 | <b>51</b> | <b>510</b> |
| Sam         | 4                               | 8 | 6  | 4  | 3  | 5  | <b>30</b> | <b>300</b> |
| Russell     | 2                               | 2 | 2  | 4  | 4  | 4  | <b>18</b> | <b>180</b> |
| Dan         | 4                               | 4 | 10 | 12 | 10 | 12 | <b>52</b> | <b>520</b> |
| David       | 2                               | 2 | 2  | 2  | 3  | 3  | <b>14</b> | <b>140</b> |
| Jeff        | 2                               | 2 | 2  | 2  | 2  | 2  | <b>12</b> | <b>120</b> |

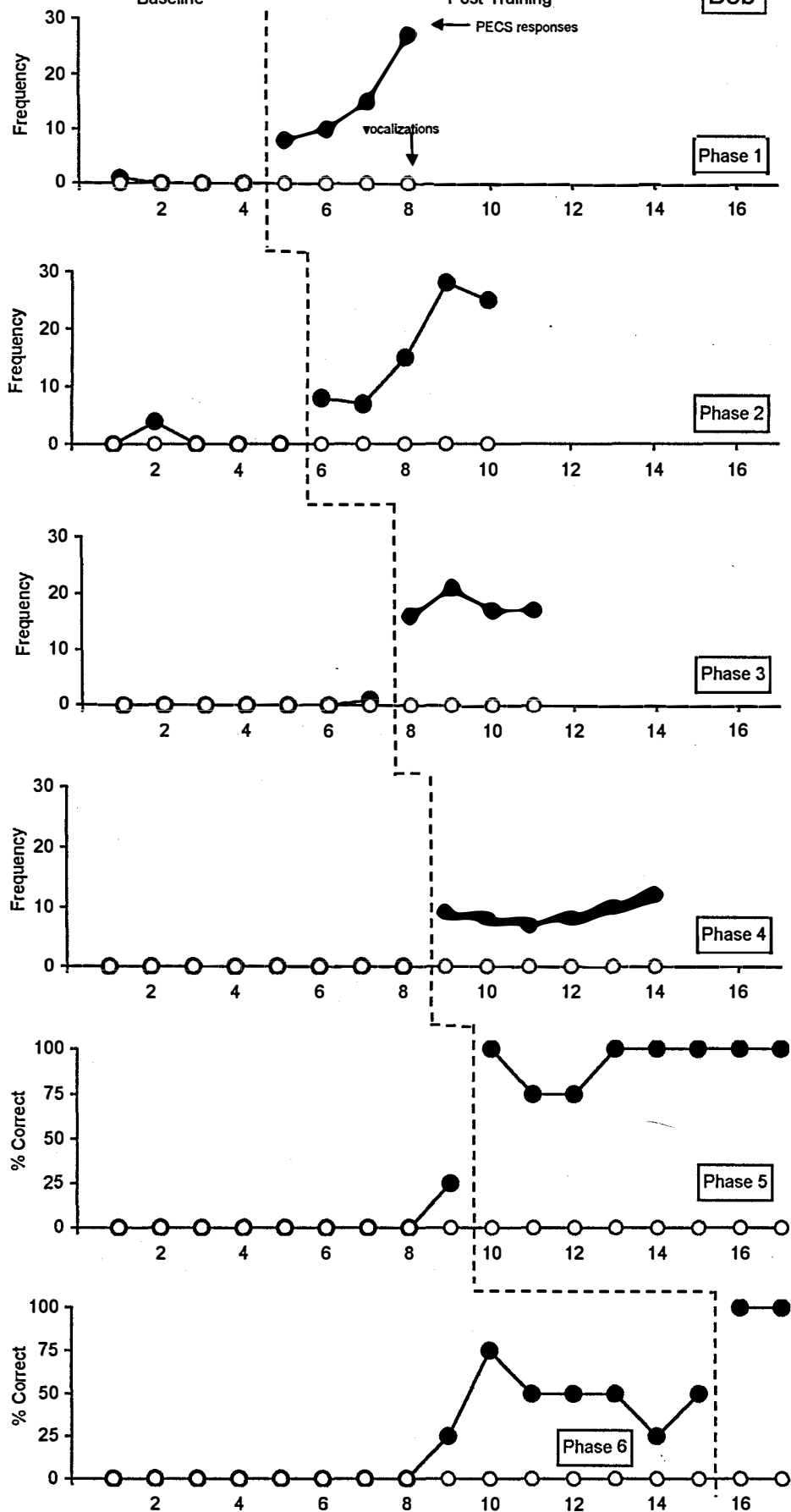


Figure 1. Frequency/percentage correct responses and appropriate vocalizations for Bob during the 6 composite testing phases of PECS

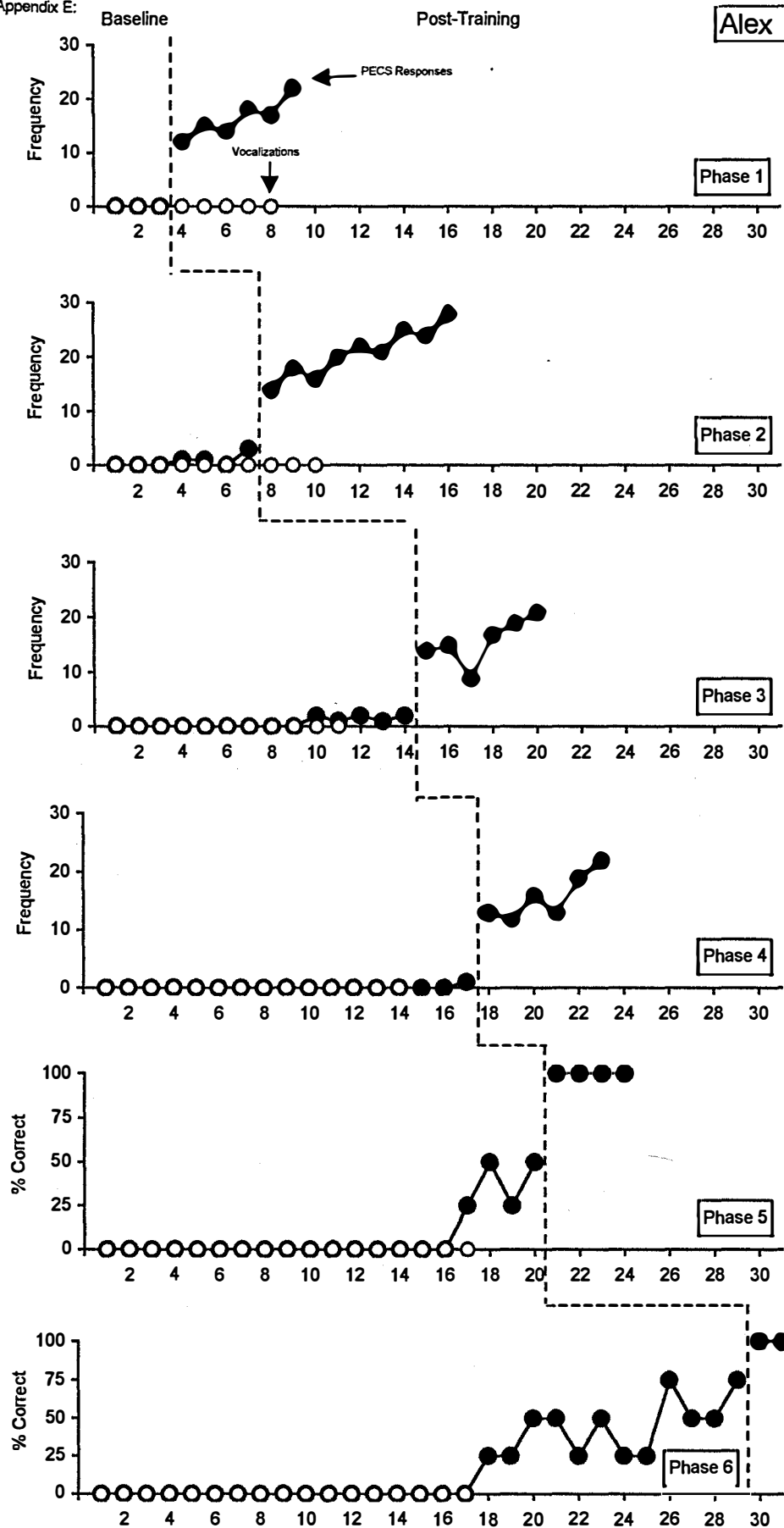


Figure 2. Frequency/percentage correct responses and appropriate vocalizations for Alex during the 6 composite testing phases of PECS

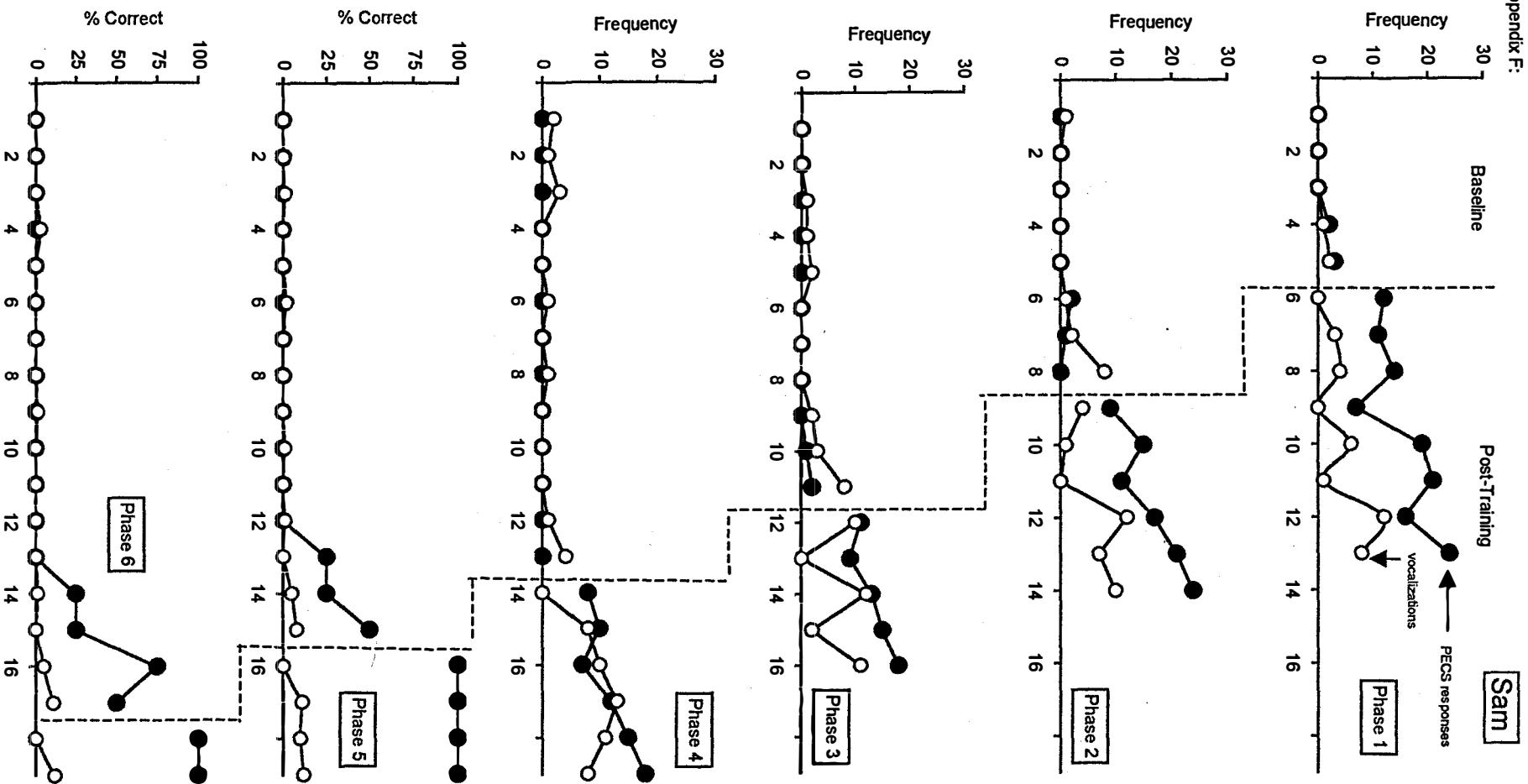


Figure 3. Frequency/percentage correct responses and appropriate vocalizations for Sam during the 6 composite testing phases of PECS

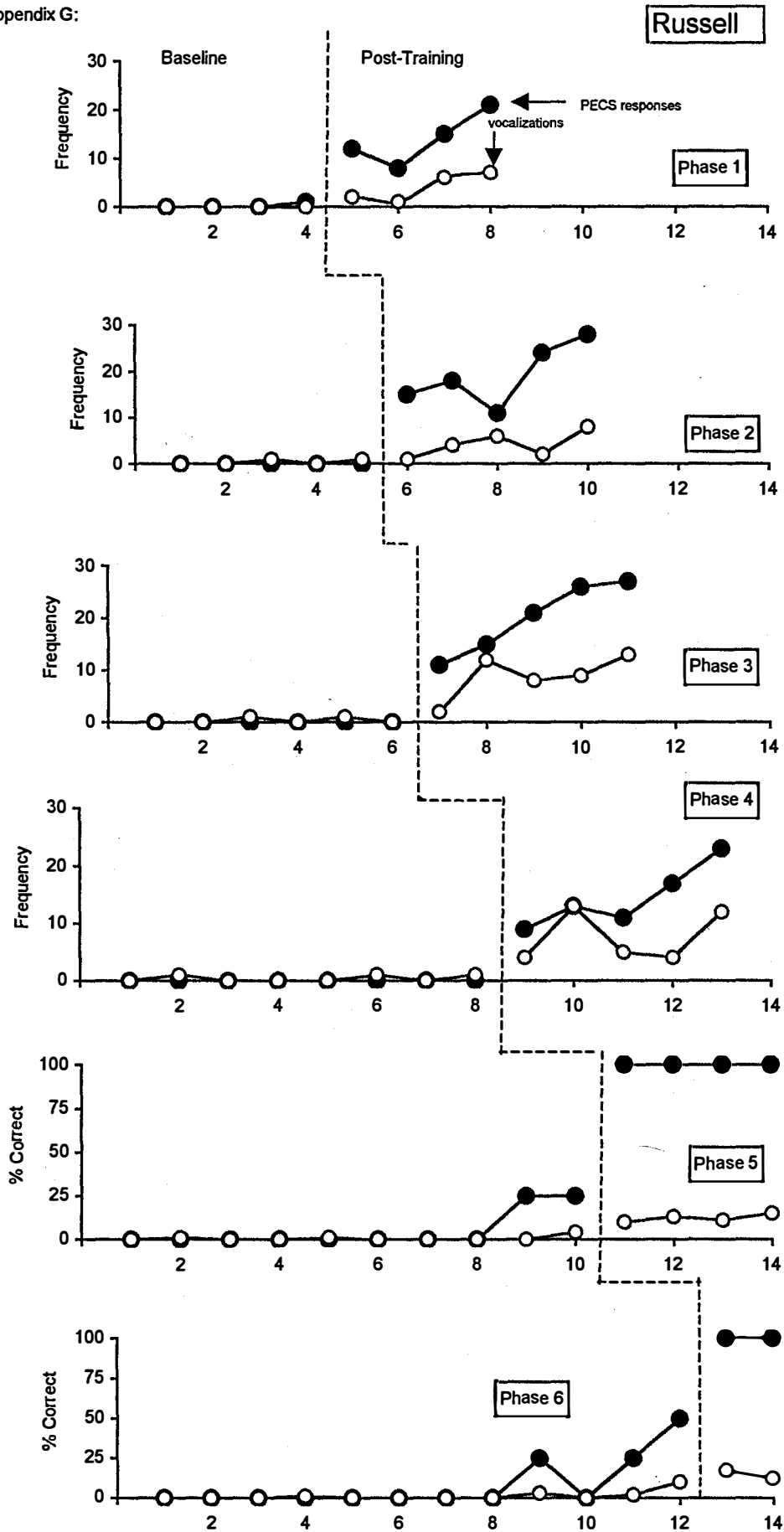
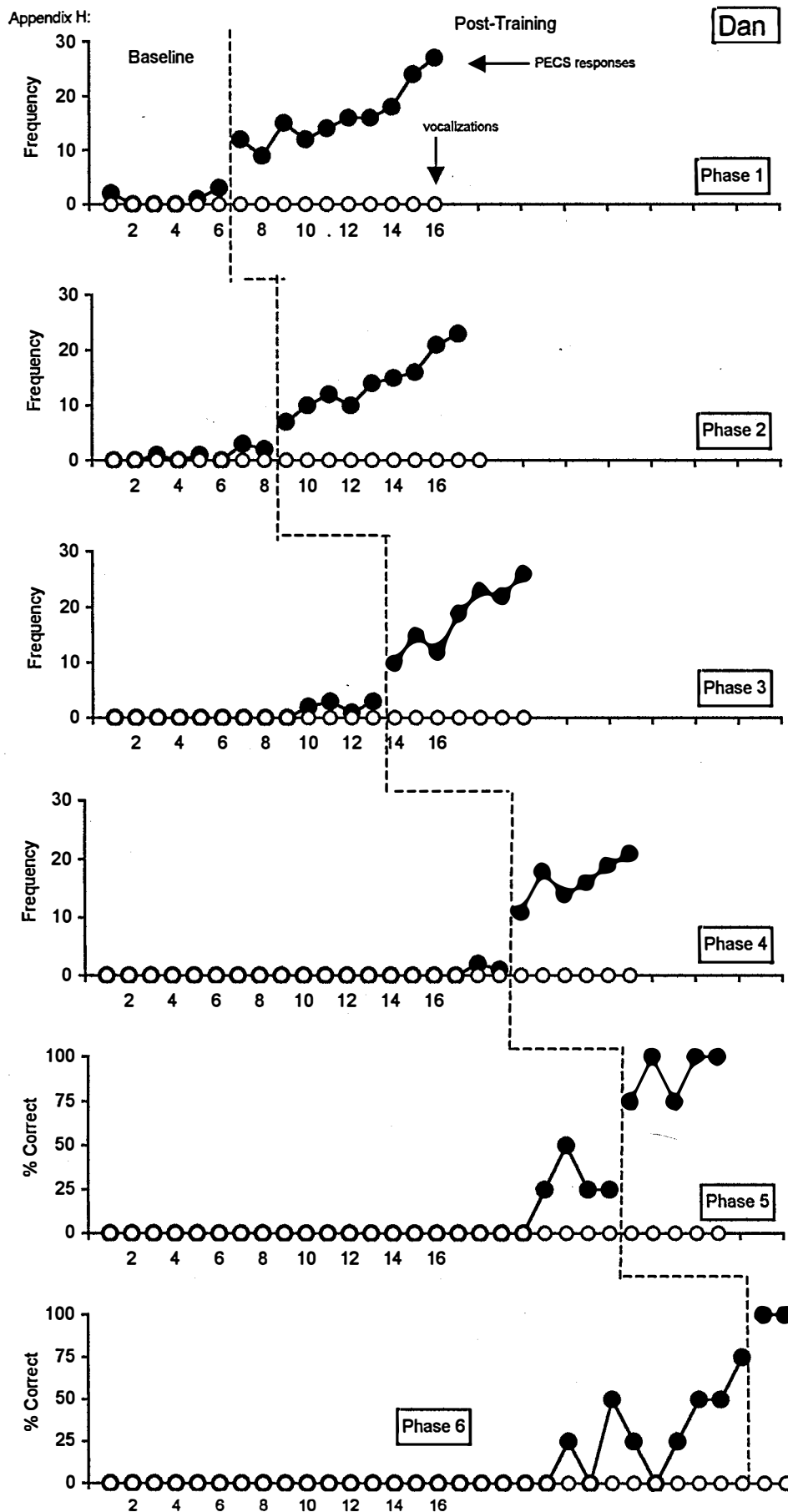


Figure 4. Frequency/percentage correct responses and appropriate vocalizations for Russell during the 6 composite testing phases of PECS



**Figure 5. Frequency/percentage correct responses and appropriate vocalizations for Dan during the 6 composite testing phases of PECS**

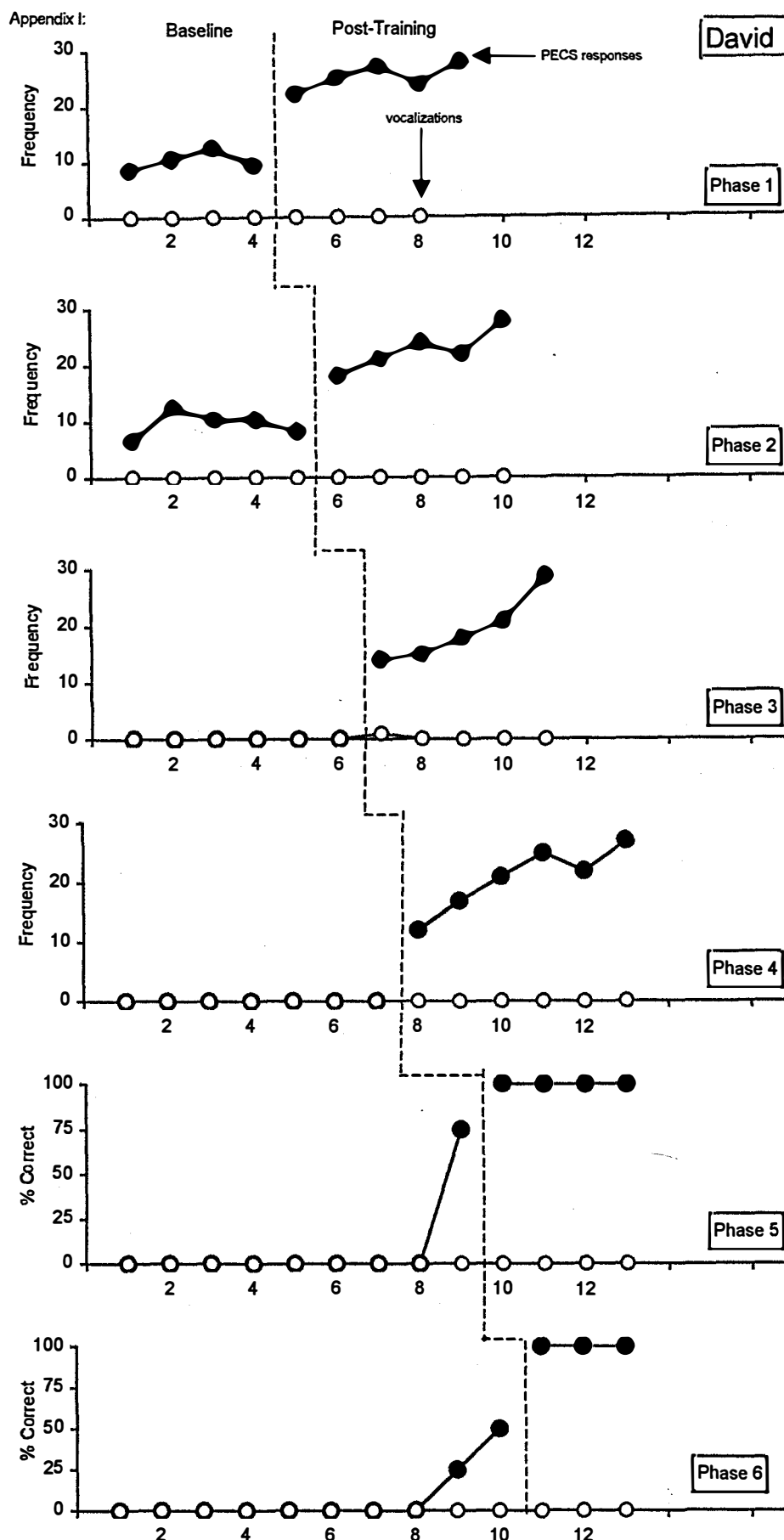


Figure 6. Frequency/percentage correct responses and appropriate vocalizations for David during the 6 composite testing phases of PECS

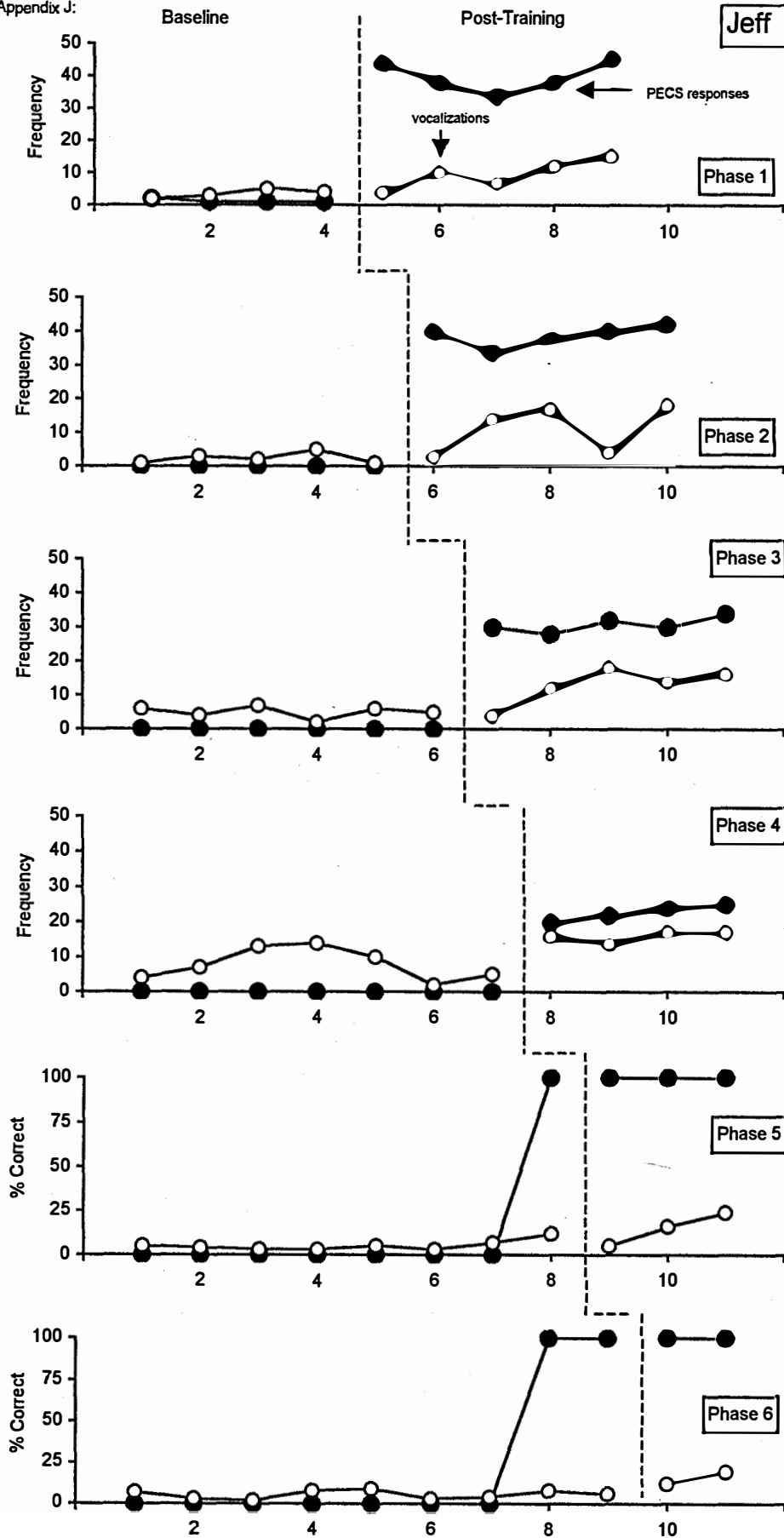


Figure 7. Frequency/percentage correct responses and appropriate vocalizations for Jeff during the 6 composite testing phases of PECS

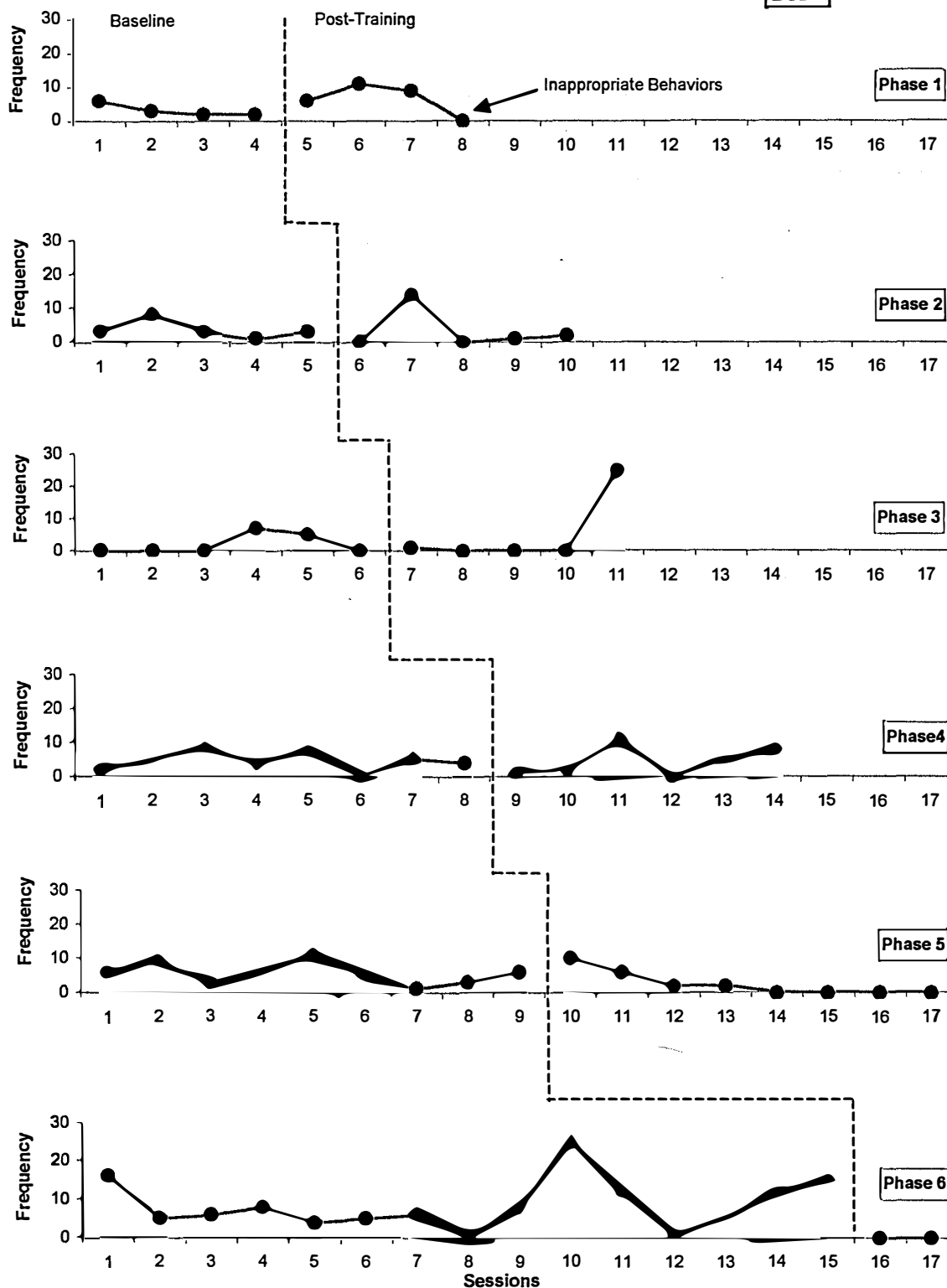


Figure 8. Inappropriate behaviors for Bob during the 6 composite testing phases of PECS

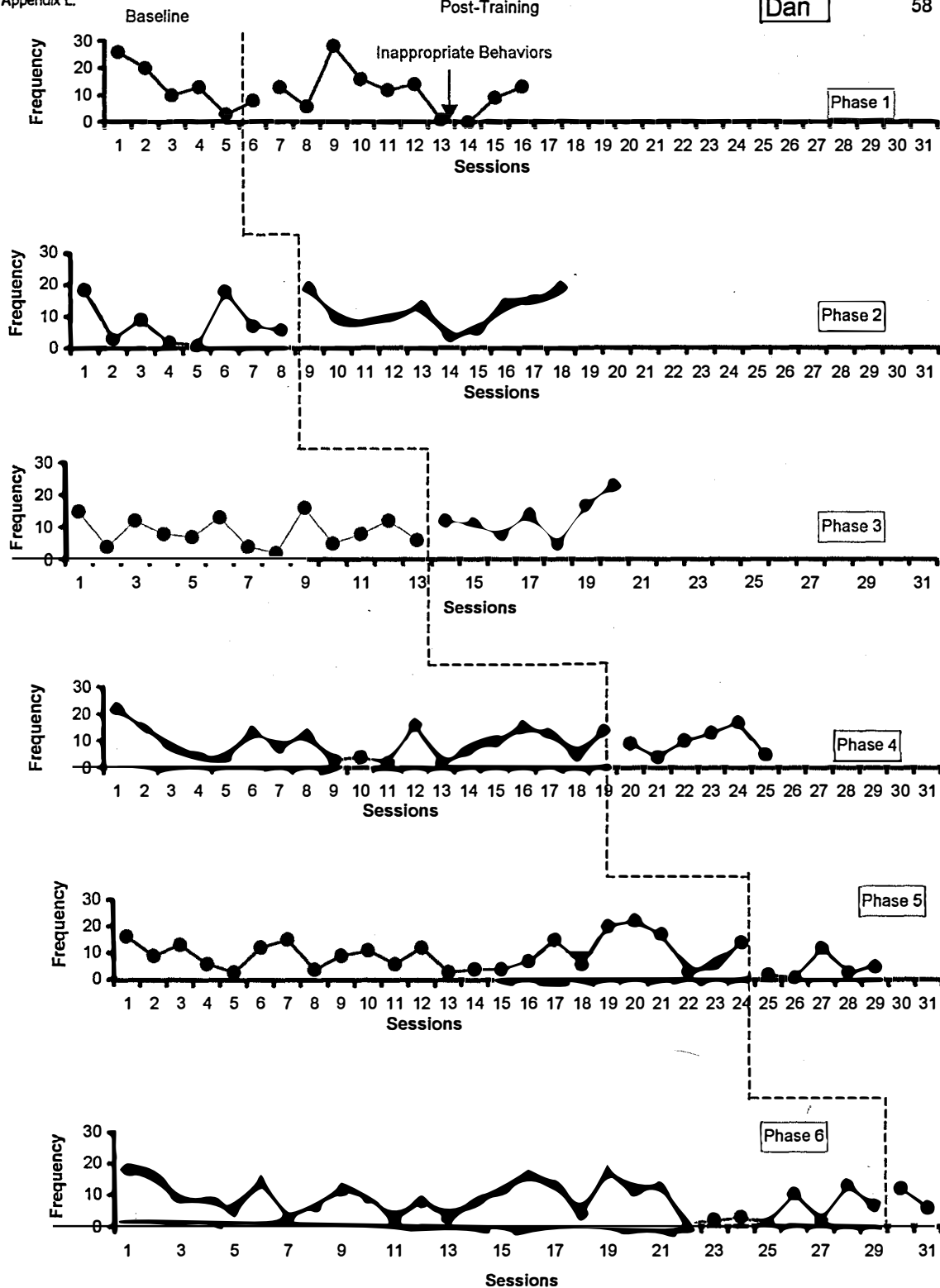


Figure 9. Inappropriate behaviors for Dan during the 6 composite testing phases of PECS

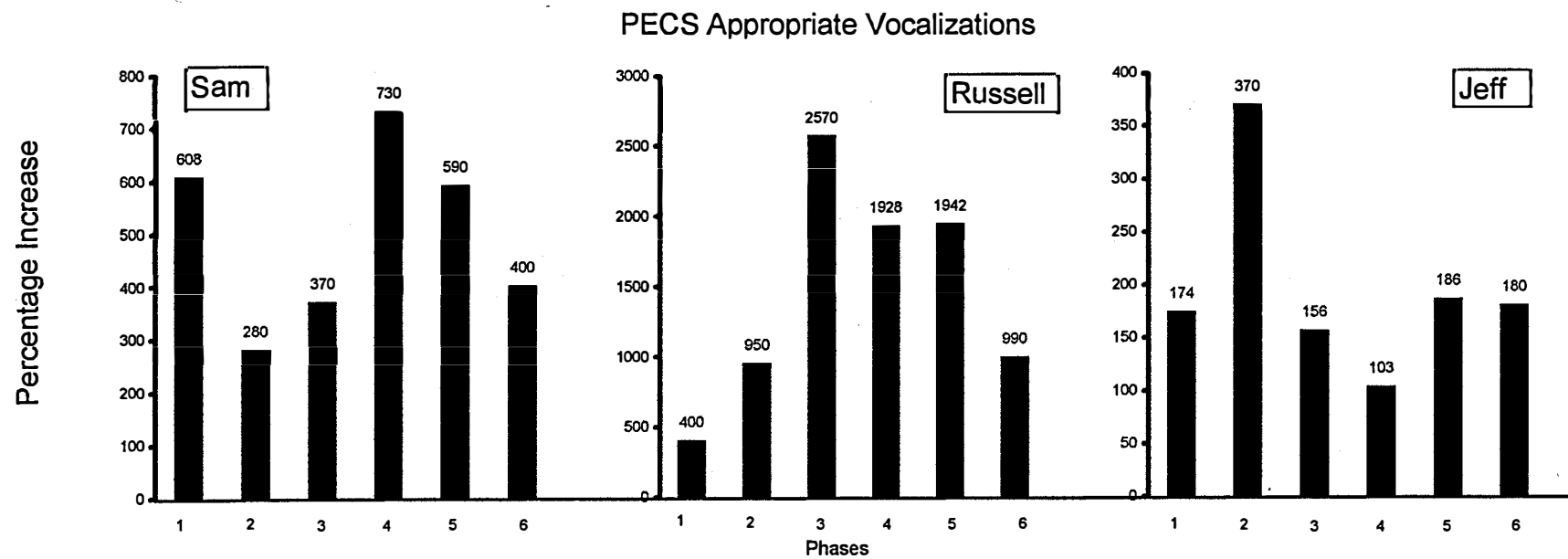


Figure 10: Percentage increases of appropriate vocalizations for 3 participants during the 6 composite-testing phases of PECS.

Appendix N:

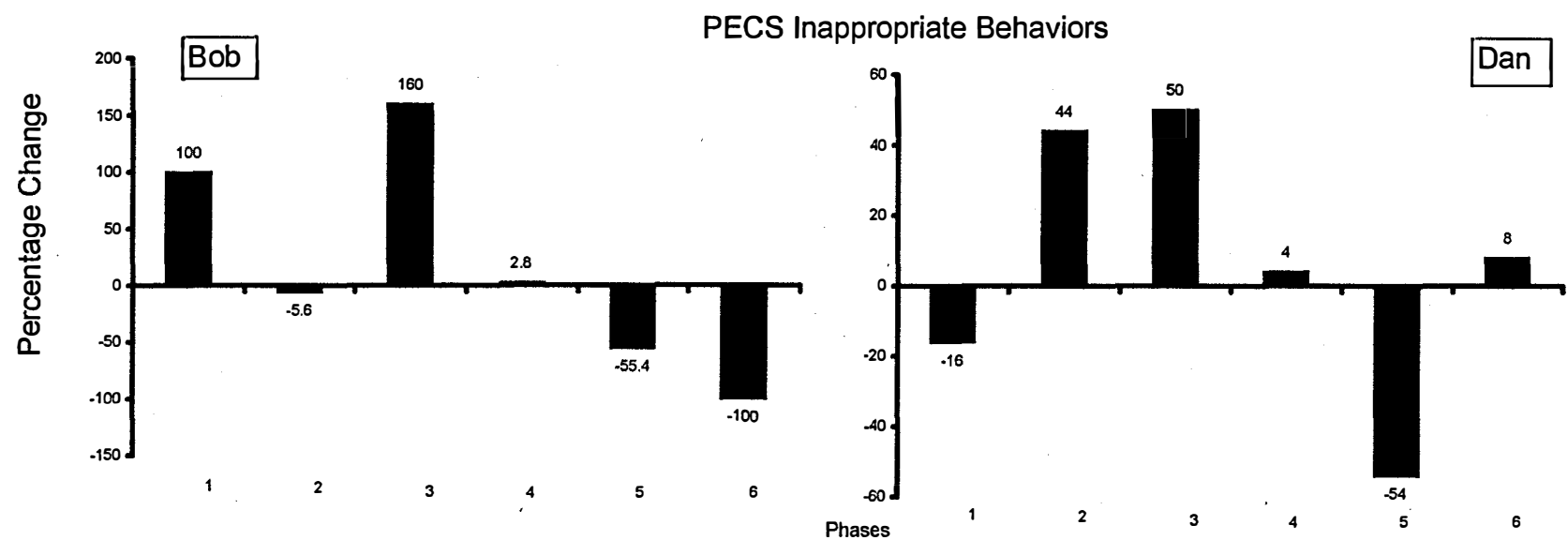
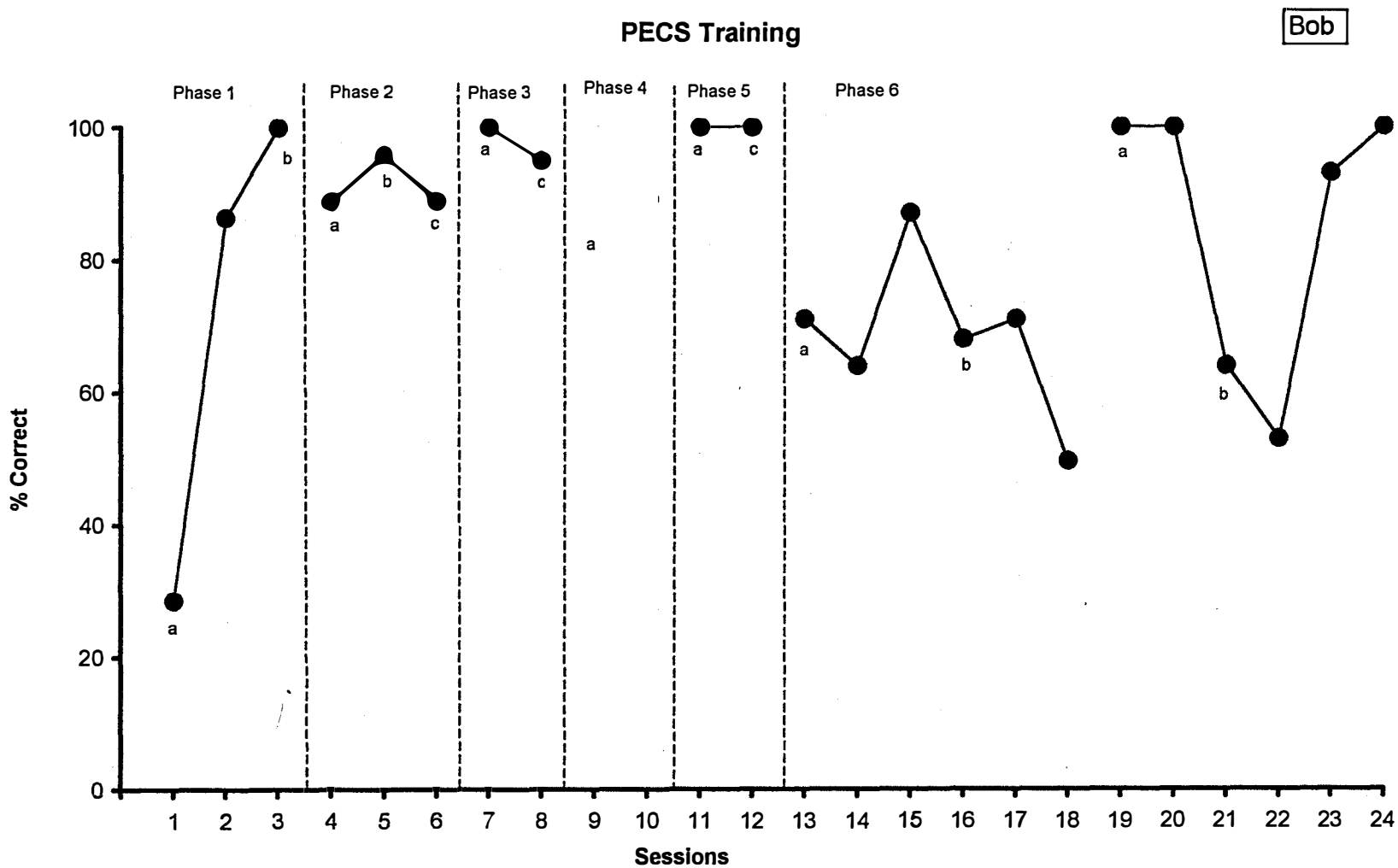
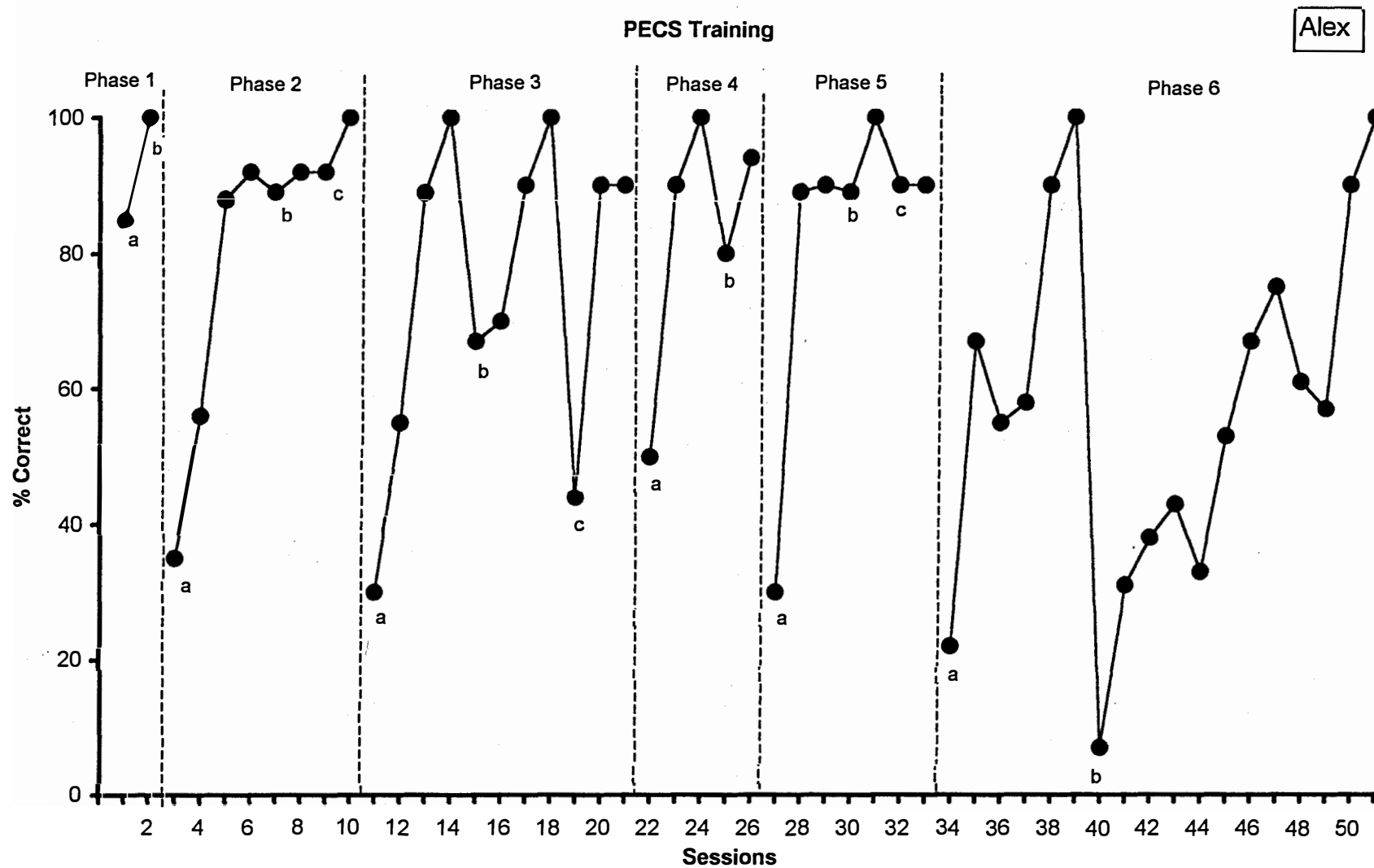


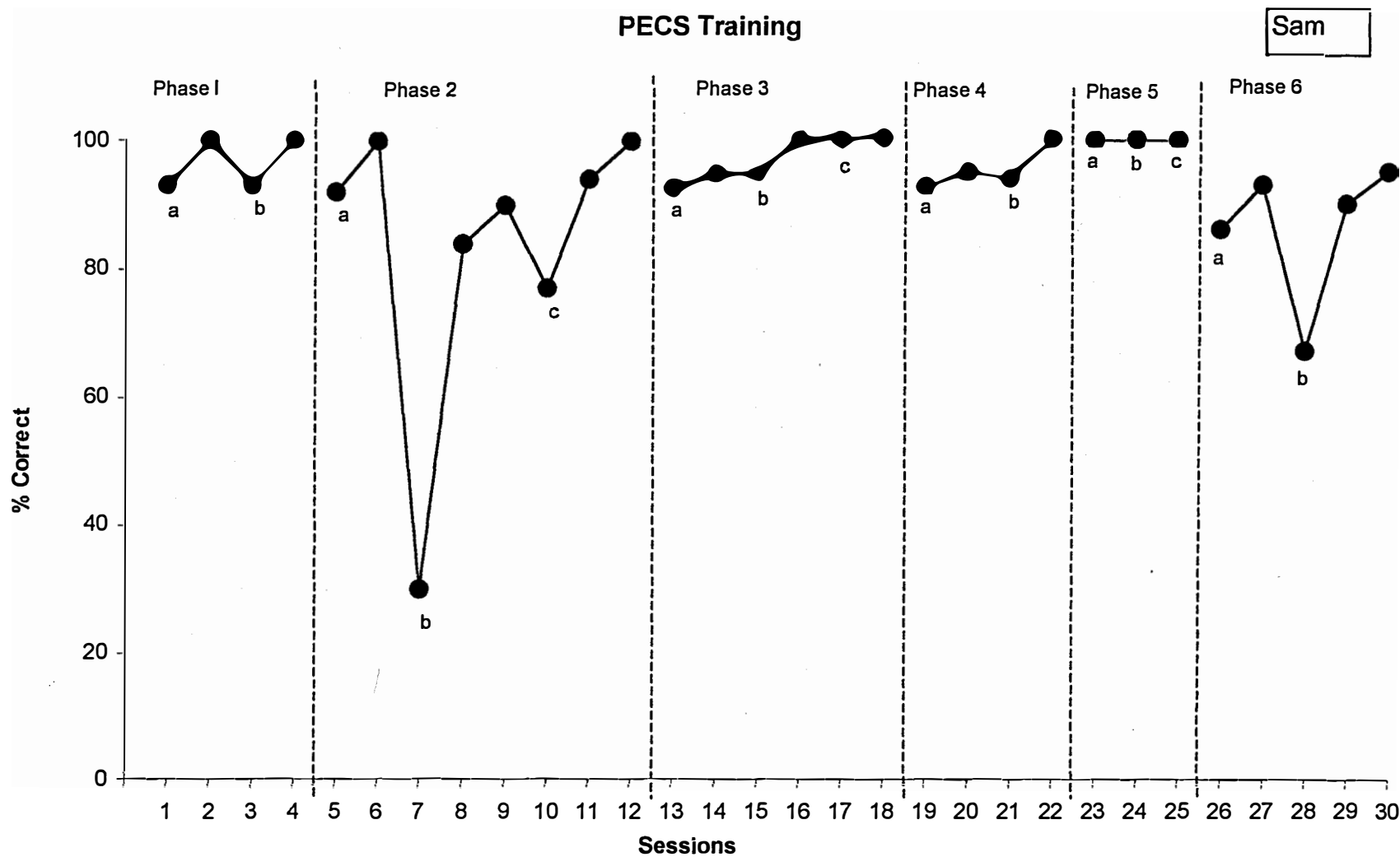
Figure 11: Percentage change of inappropriate behaviors for 2 participants during the 6 composite-testing phases of PECS.



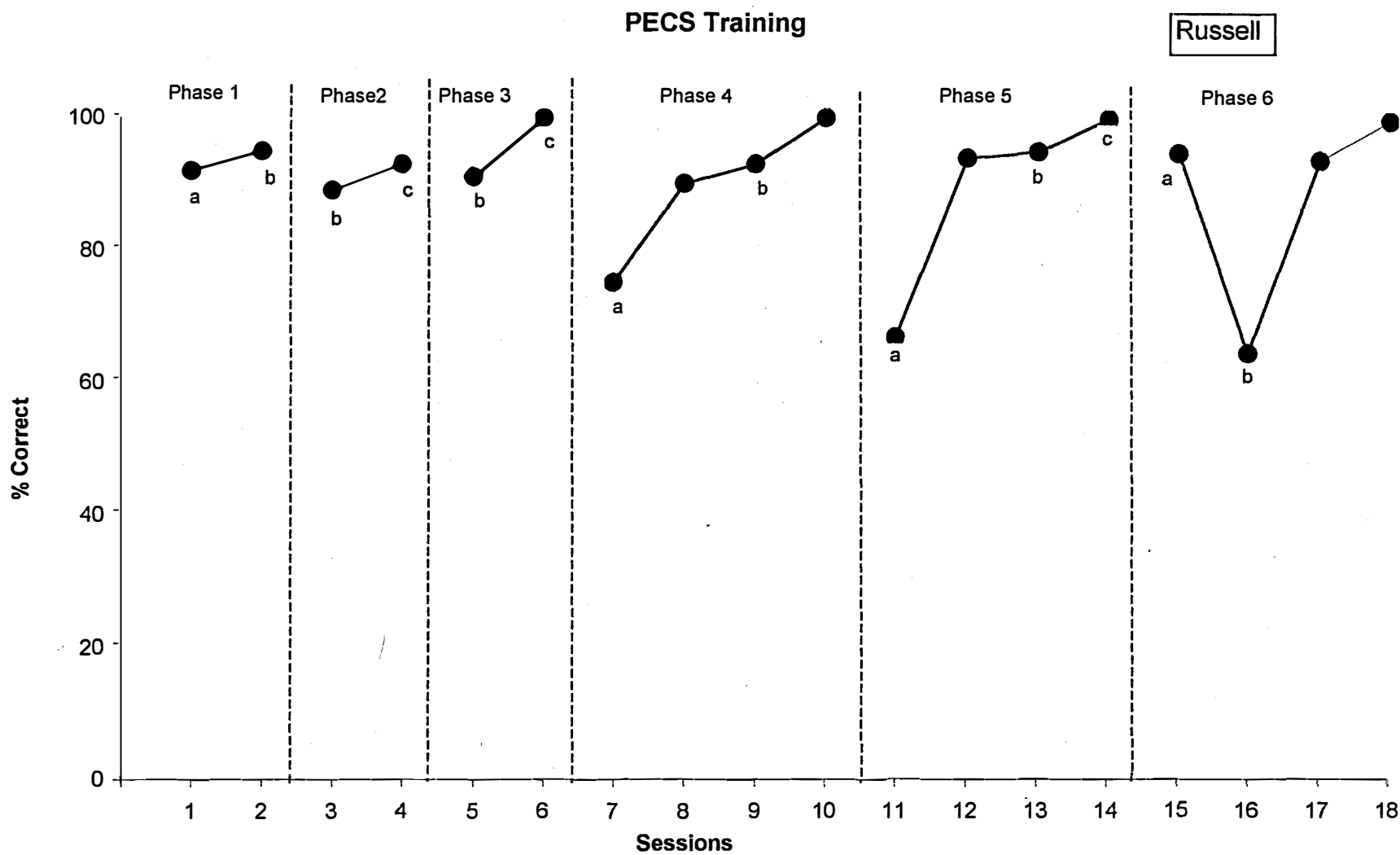
Appendix O. Percentage correct responses during PECS training phase 1 to 6 for Bob



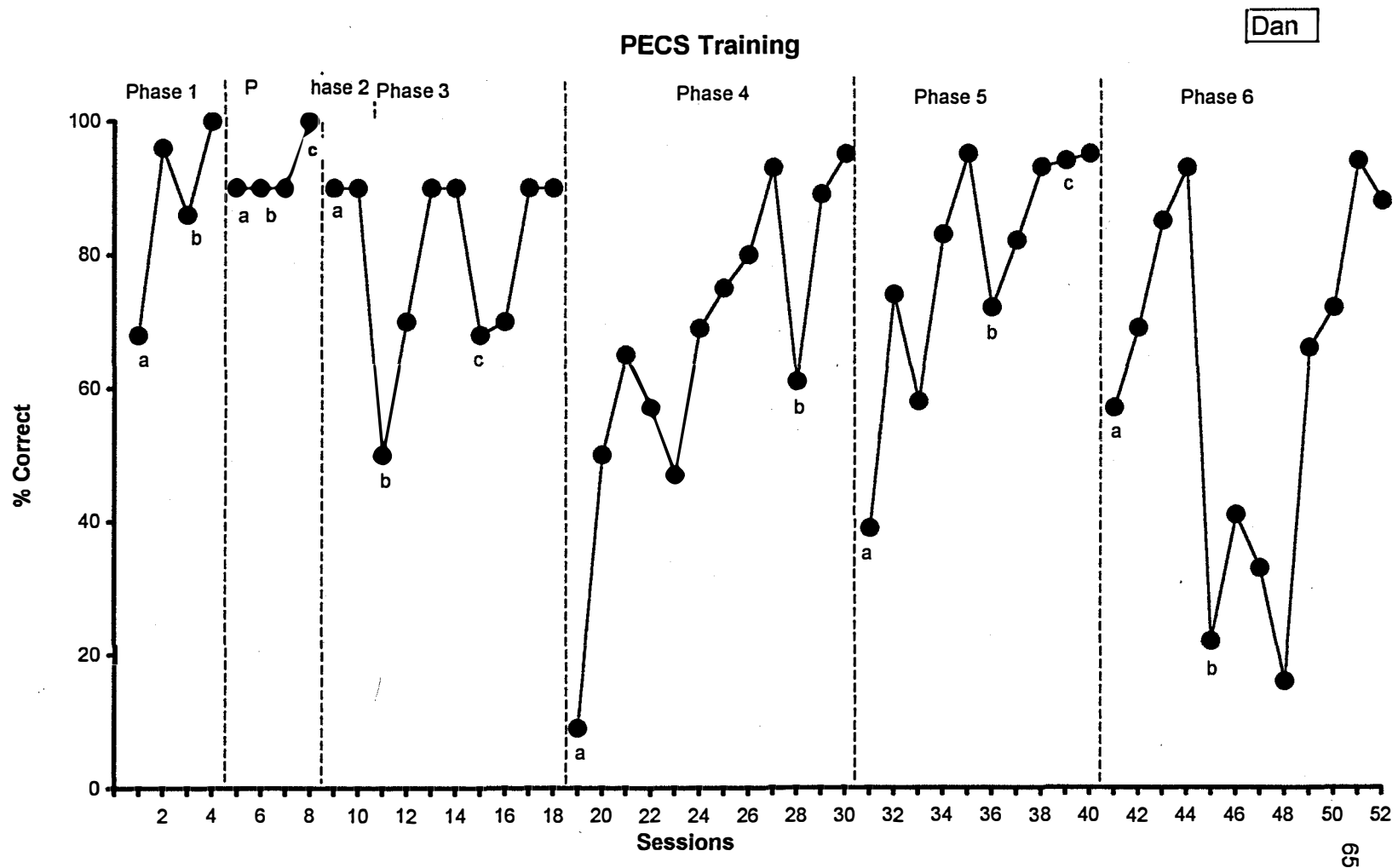
Appendix P. Percentage correct responses during PECS training phase 1 to 6 for Alex



Appendix Q. Percentage correct responses during PECS training phases 1 to 6 for Sam



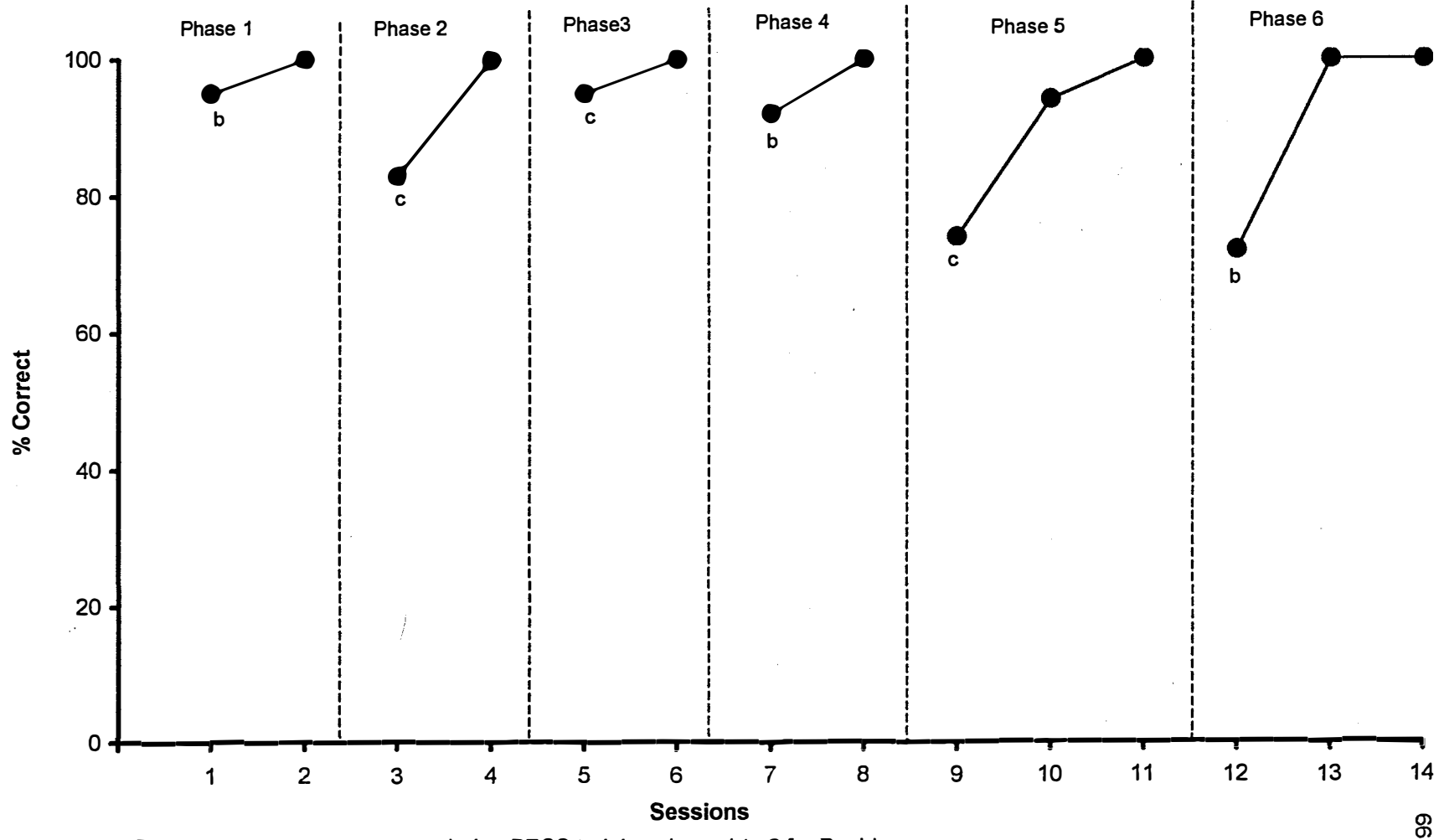
Appendix R. Percentage correct responses during PECS training phase 1 to 6 for Russell



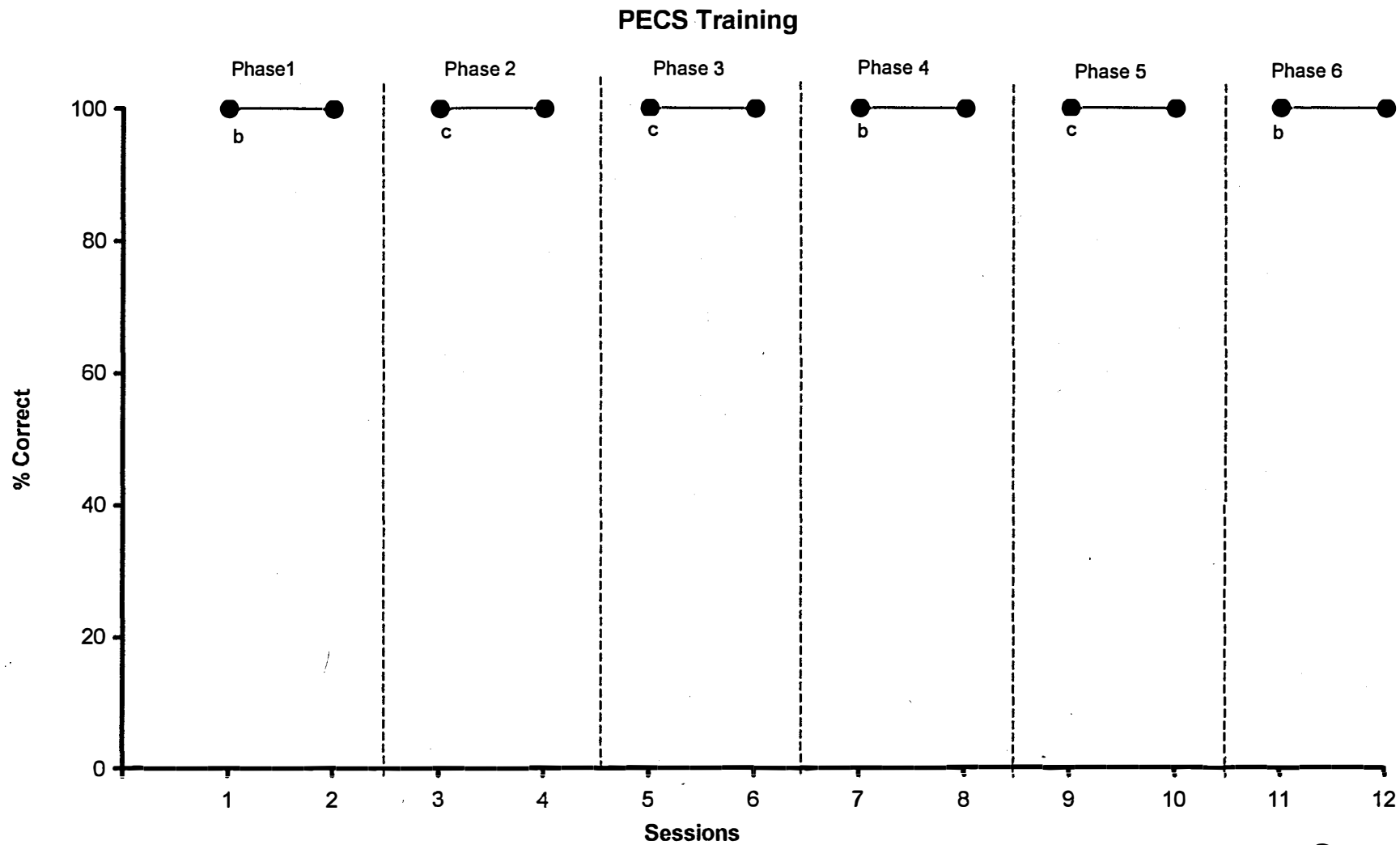
Appendix S. Percentage correct responses during PECS training phase 1 to 6 for Dan

## PECS Training

David



Appendix T. Percentage correct responses during PECS training phase 1 to 6 for David



Appendix U. Percentage correct responses during PECS training phase 1 to 6 for Jeff



Appendix V:

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WESTERN MICHIGAN UNIVERSITY

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Date: October 10, 2001

To: James Carr, Principal Investigator  
Anne Cummings, Student Investigator for thesis

From: Mary Lagerwey, Chair

A handwritten signature in cursive script, appearing to read "Mary Lagerwey".

Re: Changes to HSIRB Project Number 01-02-11

This letter will serve as confirmation that the changes to your research project "Evaluation of the Picture Exchange Communication System" requested in your memo dated October 8, 2001 have been approved by the Human Subjects Institutional Review Board.

The conditions and the duration of this approval are specified in the Policies of Western Michigan University.

Please note that you may **only** conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: February 21, 2002

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x *May Zagory*  
HSIRB ChairWESTERN MICHIGAN UNIVERSITY  
- DEPARTMENT OF PSYCHOLOGY -*Permission of Parent or Guardian**Principal Investigator:* James E. Carr, Ph.D.*Student Investigator:* Anne Cummings, B.A.

My child has been invited to participate in a research project, entitled "Evaluation of the Picture Exchange Communication System." The purpose of this study is to evaluate the Picture Exchange Communication System (PECS) by teaching children with developmental delays (including autism) to use PECS and observing if there are any changes in speech and problem behaviors. PECS is a communication system in which children are taught to communicate by exchanging with adults small pictures that represent objects/activities for those same objects/activities (and for adult attention). Children are generally taught how to request and comment with PECS.

My permission for my child to participate in this project means that my child will have an individualized experimental treatment conducted in a therapy room at Western Michigan University by a trained graduate student. The treatment is intended to increase my child's functional communication skills, possibly increase my child's speech, and possibly reduce the occurrence of my child's problem behavior. The study includes six phases of PECS training, which are described below. The study will begin in Phase I and move to the next phases when my child has "mastered" each phase.

1. Phase I – Teaching the picture exchange. The goal of this phase is to teach my child how to exchange a picture of a preferred item (for example, a toy).
2. Phase II – Spontaneity. The goal of this phase is to teach my child how to go to a communication board, select a picture, and hand it to the experimenter.
3. Phase III – Discrimination of pictures. The goal of this phase is to teach my child how to distinguish between different pictures of items.
4. Phase IV – Sentence structure. The goal of this phase is to teach my child how to request items by creating sentences with pictures.
5. Phase V – Responding to "What do you want?". The goal of this phase is to teach my child to answer the question "What do you want?" by using the picture system.
6. Phase VI – Responding to "What do you see?". The goal of this phase is to teach my child to answer the question "What do you see?" by using the picture system.

Please be aware that you will be responsible for transporting your child to campus for all research sessions. In a typical session, my child will be in a 10' X 8' room containing 1 small table, 2 small chairs, a PECS binder, pictures, and necessary exchange items (for example, toys) that will remain in plastic containers out of my child's reach. The experimenter will then begin a stopwatch to record the session, which will last about 10 minutes. At certain times throughout the session, the experimenter will ask my child questions, prompt him/her

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x-*May Zagury*  
HSIRB Chair

to hand over a picture, and present preferred items as rewards. Each session will last about 20 minutes and the experimenter will conduct about 3 sessions per visit. Approximately 3-5 visits will be scheduled each week. The duration of the entire study will ultimately depend on my child's progress, but the study is generally not expected to exceed 3 months.

The benefits my child may receive include: (a) the ability to communicate using pictures, (b) increases in speech, and (c) decreases in problem behavior. In addition, my child will be able to bring the PECS program home after the experiment is over. However, in the event that the experimenters are unsuccessful in teaching PECS, there may be no benefits resulting from participation in the study.

The primary risk associated with participation in this study is that my child may experience some frustration at being presented with communication tasks. If my child shows signs of distress (for example, crying), sessions will be terminated. If four sessions in a row are terminated due to my child's distress, he or she will be excused from the study without penalty. As in all research, there may be unforeseen risks to my child. If an accidental injury occurs, appropriate emergency measures will be taken; however, no compensation or treatment will be made available to me or my child except as otherwise specified in this permission form.

All of the information collected in this study will remain confidential. That means that my child's name will be omitted from all data collection forms and a code number will be attached. The principal investigator will keep a separate master list with the names of the children and the corresponding code numbers. No names will be used if the results are published or reported at a professional meeting. During the study, the staff may videotape the sessions with my child. These videotapes are to be used only for the purposes of data collection and are to be kept confidential. All information and videotapes will be stored for at least 3 years in locked file cabinets in the Child Behavior Research Laboratory (Wood Hall - 1526) at WMU. Only research staff involved with this project will have access to these videotapes.

Regardless of my child's participation in the study, the experimenters will, at my request, inform me about alternative services in the community for my child. At any time, I may withdraw my child from this study. Refusal to participate or withdrawal from this study will not negatively affect my child's opportunity to receive therapeutic services at the WMU Center for Autism or their ability to seek other services through independent vendors or school systems. If I have any questions or concerns about this study, I may contact either of the Investigators, Dr. James E. Carr (616-387-4925) or Anne Cummings (616-387-4629). I may also contact the Human Subjects Institutional Review Board (616-387-8293) or the Vice President for Research (616-387-8298).

This permission document has been approved for use for one year by the Human Subjects Institutional Review Board as indicated by the stamped date and signature of the board chair in the upper right corner. I will not participate in this project if the corner does not have a stamped date and signature.

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x *Mary Lagravy*  
HSIRB Chair

## Evaluation of the Picture Exchange Communication System

Dear parent,

We are members of the Psychology Department at Western Michigan University and we work with children who have developmental disabilities. We are currently conducting a study on the effects of the Picture Exchange Communication System (PECS). We will be working with some children who have developmental delays (including autism), and your child may have an opportunity to participate. We are hoping to find children between the ages of 2 and 12 who currently (a) do not use recognizable words, and (b) have had no previous training with PECS. Children who participate in our study will receive (a) individualized training in PECS, and (b) will be able to keep their own PECS communication binder system at the end of the study. If you are interested in speaking to someone about the details of this study, please feel free contact either of us.

**Anne Cummings**  
Doctoral Student  
Western Michigan University  
387-4629  
anne.cummings@wmich.edu

**James E. Carr, Ph.D.**  
Assistant Professor  
Western Michigan University  
387-4925  
jim.carr@wmich.edu

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x. Mary Zager  
HS/IRB Chair

My signature below indicates that I, as parent or guardian, can and do give my permission for \_\_\_\_\_ (child's name) to participate in the previously described experimental intervention.

\_\_\_\_\_  
Parent Signature\_\_\_\_\_  
Date\_\_\_\_\_  
Permission Obtained By\_\_\_\_\_  
Date