TRAINING PARAPROFESSIONALS TO IMPLEMENT THE PICTURE EXCHANGE COMMUNICATION SYSTEM (PECS)

By

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To John Richards and Eric Sloman, I'll take mine medium

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Based on Skinner's *Verbal Behavior* (1957), the picture exchange communication system (PECS) was designed to teach children with autism functional verbal behavior. Much research has demonstrated the effectiveness and efficiency of PECS in building verbal behavior. However, because PECS training is typically presented in a group format and later discontinued (Howlin et al., 2007), decreases in treatment integrity may result in loss of effectiveness and durability. Hence, more intensive approaches may be necessary to establish, generalize, and maintain PECS delivery skills for educators beyond those demonstrated in workshop or group consultation trainings. Therefore, the purpose of the study was to examine the effects of a feedback model developed by Marcus, Swanson, and Vollmer (2001) to teach paraprofessionals to implement PECS with a high degree of integrity using single subject design methodology. The study examined the performance of paraprofessionals and students, as well as the extension and maintenance of PECs implementation. Implications for PECS training, and PECS training protocol are discussed in establishing and maintaining PECS delivery with integrity.

CHAPTER 1
LITERATURE REVIEW

Introduction

Definition and Prevalence of Autism

Autism is a syndrome consisting of stereotyped behavior, social withdrawal, and deficits in expressive and receptive communication (American Psychiatric Association, 2000). Autism falls under the spectrum disorder category of pervasive developmental disorders (PDD). The PDD diagnostic category encompasses Autism, Asperger's Syndrome, Rett's Syndrome, Childhood Disintegrative Disorder, and Pervasive Developmental Disorder- Not Otherwise Specified (National Institute of Mental Health, 2004). Currently, the estimated prevalence of autism is 7.4 out of 1,000 children (Centers for Disease Control, 2010).

Increasingly, teachers and paraprofessionals work with children diagnosed with autism in inclusive and special education settings. This increase is evidenced in the rising percentage of students diagnosed with autism served under Part B of the Individuals with Disabilities Education Improvement Act (IDEA) of 2004. For example, the percentage of students with autism served under IDEA Part B has increased on average 15.7% per year from 2004 to 2007 (Westat, 2004; 2005; 2006; 2007). As the number of students with autism enrolled in special education increases, educators must cope with the corresponding increase in challenging behavioral topographies and skill deficits associated with this population.

To examine the issues associated with increased incidence of autism in the educational system, this paper first discusses some of the common social consequences that maintain language deficits and identifies the challenges encountered

by educators working with this population due to these deficits. Additionally, this paper discusses different perspectives of examining language deficits, identifies categories of the interventions used to address these deficits, and reviews research on a popular package that attempts to remediate deficits in communication.

Language Deficits

Due to the well-documented language deficits associated with autism, educators frequently encounter obstacles to success and are more inclined to present breaks and/or attention when challenging behavior arises. Inadvertently, socially delivered consequences may shape and maintain language deficits, and cause the educator to avoid placing demands correlated with problem behavior when scheduling skill-building lessons. As repeatedly demonstrated in the *Journal of Applied Behavior Analysis* and elsewhere, behavior is sensitive to a variety of socially mediated positive (i.e., access to tangible items such as edibles and highly preferred toys, and/or attention) and negative (i.e., escape from demands or avoidance of situations in which aversive stimulation is likely to be present) reinforcers (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994; Kodak, Northup, & Kelly, 2007), and it is likely that such consequences compete or interfere with acquiring functional and appropriate language (Carr & Durand, 1985). Moreover, these educator-student interactions may function to punish adult instructional behavior causing the educator to avoid situations in which problem behavior is likely to occur, thus reinforcing the use of non-instructional activities and punishing the placement of instructional demands on the student (Carr, Taylor, Robinson, 1991).

Another potential source maintaining deficits can arise when educators infer the needs of a student. Educators may infer or hypothesize the intent behind the student's actions based on previous experiences with other students. For example, the student

may cry evoking the educator to provide attention (i.e., “What do you want?”), hand the student a tangible item (i.e., a favorite toy), and/or terminate demands based on similar experiences with other students in similar situations. Additionally, the latency between stimulus delivery and behavior (i.e., analogous to a delay to reinforcement procedure) may produce extinction induced problem behavior, with the educator attempting to “guess” what the student “wants” until problem behavior terminates; thus reinforcing the escalation of problem behavior. These circumstances decrease or even eliminate instructional time allocated to teaching communication, reduce instances to reinforce appropriate communication, decrease opportunities for the student to acquire communication skills, and potentially increase inappropriate behavior (Carr et al. 1991; Sundberg & Michael, 2001). In total, the interactions may serve an unintended effect -- the absence of communication acquisition and maintenance of language deficits. In order to untangle these interacting educator-student variables, it may be useful to provide a model for understanding communication.

A Model for Understanding Communication

To simplify the complex nature of environmental variables maintaining language deficits, one can identify two sources of influence: the listener and the speaker. In the context of educational settings for individuals with autism, listeners (i.e., caregivers, educators, peers) may ineffectively respond to the speaker (i.e., individual with autism) because of the listener’s lack of history with responding effectively to the observed behavior (Sundberg & Michael, 2001). At the same time, the speaker’s topography of behavior is not usually associated with a familiar communicative act. As a metaphor for understanding the communication problems encountered by children with autism, consider a monolingual English speaker traveling to France. The English speaker

traveling to France decides to eat lunch at a Parisian restaurant. At the restaurant, the English traveler (the speaker) asks a monolingual French waiter (the listener) for a glass of water. The waiter, unable to understand English, may bring another kind of beverage, a meal, or nothing at all, and not the requested water. The English speaker shakes his head no at the waiter, and the waiter brings something else until the waiter brings the water. In an analogous yet extreme example, consider a student (the speaker) who hits his head to obtain attention, yet the educator (the listener) lacks the responses necessary to address the student's head hitting without maintaining it. Furthermore, the student's head hitting does not approximate appropriate responses to which the listener can effectively respond, thus adding to the sources that maintain and escalate problem behavior.

Clearly, attributing the mismanagement of behavior to the educator is unjustified when faced with these kinds of situations: a skill deficit in knowing how to decrease problem behavior (e.g., head hitting), while attending to the student without reinforcing the problem behavior. Similarly, blaming the student is unjustified, because she does not have the appropriate expressive communicative behavior that can be discriminatively reinforced by the listener. One approach that has been utilized to address the difficulties associated with communicative deficits is behavior analysis.

Behavior Analytic Approach

Behavior analysis addresses the challenges of managing problem behavior from communicative deficits and inappropriate behavior mediated by adult delivery of reinforcement. Behavior analysis is the science of human and other animal behavior. Striving for the prediction and control of behavior through identified function, the behavior analytic database provides a multitude of examples using humans as

participants to address basic and applied behavioral issues. One discipline in behavior analysis that focuses on relevant language issues is applied behavior analysis. It has been used to address the challenges of managing problem behavior from communicative deficits and inappropriate behavior mediated by adult delivery of reinforcement.

As a discipline, applied behavior analysis seeks to address socially significant issues under a behavior analytic conceptual system to design technology through empirically derived principles (Baer, Wolf, & Risely, 1968). Some empirically derived, applied technologies stemming from the behavior analytic literature include replacing problem behavior and shaping extant unproblematic behavior (i.e., phonemes) with the acquisition and maintenance of appropriate, alternative behavioral topographies within the same operant class. One area of focus in behavior analysis is the examination of verbal behavior. The following section describes the behavior analytic departure from the traditional conceptualization of language and why this departure provides a useful paradigm that translates to interventions with students with autism.

Behavior analysis as a departure from traditional linguistic analysis

The terms “language,” “communication,” and “vocal/non-vocal verbal behavior” may appear synonymous on the surface; yet, B.F. Skinner distinguished between these superficial similarities when publishing *Verbal Behavi*or (1957). Importantly, Skinner considered the analysis of verbal behavior as concerned with function and form. According to Skinner “verbal behavior is behavior reinforced through the mediation of another person’s behavior” (Skinner, 1957, pp. 1-2). Rather than instructing a student on the response topography for labeling, requesting, and talking about oneself, Skinner’s (1957) initial framework, and subsequent refinements, examines the function

of the emitted response and its functional relation with the listener's behavior. This approach is controversial and unique when compared to traditional approaches.

Traditional approaches delineate communication and its structure by relying on familiar terms. Terms such as "nouns," "verbs," "prepositions," and "clauses" help to define meaning and units of meaning when examining the grammar of language. Under this framework, a linguist defines communication as receptive and expressive language and analyzes it from the community (vernacular) to the cultural and societal levels (Sundberg & Michael, 2001). If using a traditional linguistic approach, an educator may teach a student to respond as the community does to instructions ("Sit down"), imitate vocal responses ("Say *movie"*), and emit interrogative, declarative, exclamatory, and imperative phrases using the accepted grammar, tone, and pronunciation.

When progress to acquisition of appropriate verbal behavior remains elusive, an educator may try another intervention or search for an internal cause for the absence of positive outcomes. This approach follows from a traditional linguistic delineation of communication, and is in contrast with examining the remaining deficits (i.e., not responding appropriately to instruction and/or imitating vocal responses) as a function of the training program. Moreover, when these deficits remain or results are slow, an educator may be uncertain how to proceed or further remediate, since a traditional analysis of language emphasizes examining language practices at a community level, while deemphasizing the analysis of verbal behavior at the individual level. By examining verbal behavior at the level of the individual, the educator has the ability to identify variables that maintain verbal behavior, alter them, and, thus, change behavior (Sundberg & Michael, 2001).

The importance of examining language deficits as verbal behavior lies in the analysis of this special type of behavior at the level of the individual and the contingencies supporting its use by the individual (Skinner, 1957). One may observe the value of this approach with an example of the mand verbal operant. First, the mand is a verbal operant acquired early in life and in colloquial terms the speaker emits this verbal operant to demand or command the listener to behave in a certain way (Sundberg & Michael, 2001). As opposed to colloquial terms, the definition of a mand is functional; a mand is verbal behavior in which the consequences and establishing operations control the topography of a response (Skinner, 1957). For example, saying, “apple” may be reinforced by receiving the apple or by the delivery of a statement such as, “That is an apple,” (i.e., another type of verbal operant called a tact) depending on the context in which the individual emits the verbal statement (Sundberg & Michael, 2001).

Each of these verbal operants (the mand and tact) is under control of different variables, therefore saying “apple” has a different function or consequence associated with its use, although the topography is similar and the part of speech is identical on both occasions (Skinner, 1957). In the former case, the utterance “apple” is a mand if the particular consequence (i.e., stimulus class) maintains the particular topography of the response as a member of the mand operant class (i.e., saying the word “apple,” handing a PECS card with an “apple” depicted, producing the sign for “apple” in American Sign language preceding the delivery of the apple) (Skinner, 1957). In the latter case, the utterance is a tact if the consequences are non-specific (i.e., generalized conditioned reinforcer such as approval) and under stimulus control of an “object, event, or property of an object or event” (Skinner, 1957, p. 82). Unlike the mand, the

consequences for tact are non-specific, meaning the verbal behavior emitted lacks correspondence between saying “apple” and consequence of receiving the apple. Therefore, although the form and part of speech of the response are the same, the consequences (stimulus class/controlling variables altering the probability of the verbal operant) are different. By using a behavior analytic approach, verbal operants can be taught in specific ways according to their function to enhance acquisition (Sundberg & Michael, 2001). The section below discusses types of language acquisition technologies, which combined with a behavior analytic perspective, may have implications for children with autism developing functional and appropriate verbal behavior. Ultimately, the discussion leads into a review of a language acquisition package that emerges from the behavior analytic formulation of verbal behavior and has relevance to the autism population.

Types of Language Acquisition and Training Technologies

Currently, educators have a variety of language acquisition and training technologies to select from. Some treatments, such as functional communication training (differential reinforcement of communication or mand training) and tact training, integrate a behavior analytic perspective and apply it to language training programs. Other treatments, such as Responsive Education and Prelingustic Milieu Teaching (Yoder & Stone, 2006a; 2006b), are built upon alternative approaches to communication that strive for the terminal goal of appropriate language use. These treatments have been systematized and disseminated to a wider audience in the form of training packages. Professionals often refer to these training packages as augmentative and alternative communication (AAC) systems. Before introducing how these systems are classified, there is one caveat: despite the variety of these systems, not all have

theoretical foundations in behavior analysis nor use procedures derived from applied behavior analysis. Therefore, one rationale for introducing the classification scheme is to provide context to the package that will be reviewed.

AAC Systems

AAC systems attempt to compensate either temporarily or permanently for the deficit patterns of individuals with severe expressive communication disorders using integrated components such as symbols, strategies, aids, and techniques (Cumley, 1992). According to Cumley (1992), AAC systems can be classified along the following dimensions: (a) augmentative or alternative, (b) aided or unaided, and (c) topography-based or selection-based. Descriptions of each of these classification dimensions are provided below.

One can distinguish AAC systems based on the level of support: augmentative systems supplement existing speech, while alternative systems serve as the primary means of communicating (Mirenda, 2003). However, the level of support is not mutually exclusive in some systems, some range from an exclusively alternative to augmentative system.

Additionally, one can classify AAC systems as either unaided or aided. Unaided communication applies to systems that do not require any equipment external to the body and use symbols such as manual signs, pantomimes, and gestures (Mirenda, 2003). Alternatively, aided communication systems use devices that are external to the body and consist of using symbols such as photographs, line drawing, letters, and electronically presented words (Mirenda, 2003). Along with the previous note about AAC systems, individuals may use a combination of both AAC systems to communicate (Beukelman & Mirenda, 1998).

Another dimension that differentiates AAC systems concerns the topography of verbal behavior following acquisition: systems are either topography-based or selection-based. In topography-based systems, responses vary in form and selection of the stimulus, but the stimulus does not appear in a stimulus array, such as a book (Bondy et al., 2004). In selection-based systems, all responses are topographically similar, and require discrimination and selection of stimuli from an array (Sundberg & Michael, 2001). The implication of this dimension in the classification scheme is that verbal behavior may be non-vocal, such as exchanging of a picture for a restricted item or producing sign (refer to definition of verbal behavior), which follows the behavior analytic conceptualization of verbal behavior. In the following section, a specific AAC package, which emerges from Skinner's analysis of verbal behavior, is introduced and classified along these aforementioned dimensions. Then, a comprehensive literature review is present on this system to examine the current state of empirical findings on the acquisition of verbal behavior in children with autism.

The picture exchange communication system

The Picture Exchange Communication System (PECS) (Bondy & Frost, 1994; 2002) is an augmentative and alternative, aided, selection based communication system that may assist children with autism and communication deficits to acquire and maintain functional communication in school systems (Bondy & Frost, 2001). Bondy and Frost (1994; 2002) have based PECS on Skinner's conceptualization of verbal behavior, and have integrated methods derived from behavior analytic principles and procedures. The following identifies the phases of PECS, the intended effects on verbal behavior, and some behavior analytic procedures used during phases.

One administers PECS in phases aligned with Skinner's conceptualization of verbal behavior. Phases consist of teaching specific skills and are sequenced to build on previously acquired phases. According to protocol, PECS phases, associated with their behavioral goals, are conducted in the following order (note: phases and the verbal operant targeted are identified in the parentheses): exchanging communication cards for items (phase one; developing manding repertoire), persisting to exchange (phase two), discriminating between and using PECS cards (phase three), combining an "I" stem with the PECS cards (phase four; developing autoclitic repertoire), responding to questions (phase five; developing intraverbal repertoire), and commenting (phase six; developing tacting repertoire). Additionally, different behavior analytic techniques are integrated depending on the phase. For example, PECS is taught using backward chaining and prompt fading (phase one), delay to reinforcement/reinforcement thinning (phase two), and correspondence and discrimination training (phase three). The following is a review of PECS's empirical findings on the verbal behavior of children with autism.

Use of PECS for Children with Autism

The following literature review is a review of PECS research regarding children with autism. The research presented consists of different methodologies and purposes to account for the extant PECS empirical database. Broadly, the review contains information on the effectiveness and efficiency of PECS on functional communication, comparisons of PECS to another intervention method, and effects of PECS on speech production. Additionally, the review provides strengths and limitations of PECS and its research, and advocates for a direction for future research. Specifically, the future research outlined focuses on training educators PECS and what steps should be taken

to address limitations within this area. The scope of this paper is restricted to children with autism as Bondy and Frost designed PECS as an intervention for this population. However, this paper includes studies in which children with autism did not participate to show concomitant results with children exhibiting similar impairments, such as children with an autism spectrum disorder, a pervasive developmental disorder, or a pervasive developmental disorder not otherwise specified. This paper excludes studies on the effects of PECS effectiveness with adults, since the focus is on the school age population as they are the individuals who educators will encounter most often in practice. The subsequent section will review the impact of the intervention on verbal behavior and the length of time spanning acquisition of PECS phases.

Efficiency and Effectiveness of PECS

When operating from a best practice framework, educators are often faced with an important decision: are the time and resources allocated toward a particular treatment associated with better outcomes than implementing another treatment or even continuing with the status quo? And, if a treatment is chosen, when can one detect salient and positive treatment outcomes? Decision makers often turn to efficiency and effectiveness studies to find evidence that supports or refutes the allocation of resources in one direction or another. A prominent line of inquiry of most intervention research concerns a change in the dependant measures of interest following treatment application, and early research into PECS did not differ. Through both descriptive and experimental demonstrations, research supports PECS as a viable AAC, both in the amount of (effectiveness) and latency until (efficiency) behavior change occurs. However, there are some questions about how researchers derived their interpretations based on the data collected, as discussed in the limitations section. The following

sections review the effectiveness and efficiency of PECS overall, in comparison to other AACs, and on speech production.

Generic efficiency and effectiveness

Prior to publishing the PECS treatment manual, Bondy and Frost (1994) conducted a series of pilot studies to gather evidence on the rate of behavior change and outcomes associated with PECS implementation. One of the first in the series involved a three-year old male (Billy) diagnosed with an autism spectrum disorder (ASD) and who presented without vocal-verbal behavior. Billy progressed through the stages of PECS at a rapid pace: acquired phase one in a single day, developed an expanded manding repertoire for eight different reinforcers within the 1st month, incorporated the “I want” stem (trained in phase four) as part of his manding at the end of the 2nd month, answered questions using stems for manding and tacting during the 3rd and 4th months, and, increased emitted vocalizations and PECS card repertoire to over 100 pictures at the end of the 4th month. Similar effects were observed when implementing PECS with seven children diagnosed with autism and a group of 85 children educationally placed under autism (Bondy & Frost, 1994). Additionally, children with problem behavior identified via the Autism Behavior Checklist (ABC), exhibited reductions in ABC scores when acquiring appropriate verbal behavior (Bondy & Frost, 1994). Although these positive findings are associated with introducing PECS, in these studies PECS was introduced without experimental manipulation. Therefore, the following are results from attempts to experimentally examine the effects of PECS implementation on verbal behavior and other dependant variables using a myriad of experimental designs.

Investigators have utilized single subject designs (i.e., multiple baseline across settings/participants/behavior) and randomized and controlled group designs to attempt to provide believable demonstrations on the effectiveness and efficiency of PECS. To answer questions related to the effectiveness and efficiency of PECS, researchers have examined the results of implementing PECS on verbal behavior acquisition and expansion (Almeida, Piza, & Lamonica, 2005), challenging behavior (Frea, Arnold, Vittimberga, & Koegel, 2001; Malandraki & Okalidou, 2007), and types of appropriate behavior (Carr & Felce, 2007a/2007b; Heneker & MacLaren-Page, 2003; Howlin, Gordon, Pasco, Wade, & Charman, 2007). Researchers have used PECS to compete with aggressive (Frea et al., 2001) and stereotypic behavior (Malandraki & Okalidou, 2007), with observed decreases in both topographies of inappropriate behavior in a short time span (i.e., less than 15 days). In contrast, Heneker and MacLaren-Page (2003) examined PECS implementation on socially appropriate behavior with two groups of children. Specifically, the authors examined the impact of PECS on the frequency and functions of verbal behavior (Heneker & MacLaren-Page, 2003). Findings show increases in verbal behavior frequency, especially with the mand verbal operant class over 10 months of implementation. Others have found results paralleling these findings (Carr & Felce, 2007a).

Besides using direct frequency and interval recording data collection methods to examine the efficiency and effectiveness of PECS, indirect methods such as rating scales have been utilized as well. For example, similar changes following PECS introduction have been detected on checklists, such as the Rimland Autism Treatment Evaluation Checklist, for both appropriate and challenging behavior (Magiati & Howlin,

2003). Although PECS produces effective and efficient results, there are limitations to the findings that suggest a cautionary stance. These limitations are discussed below.

Limitations of the effectiveness and efficiency of PECS

Overall, researchers have found that implementing PECS results in the acquisition of appropriate verbal behavior. Yet, these conclusions are based on a body of research with a number of limitations. Below is a discussion of limitations. Limitations of the research examining the effectiveness and efficiency of PECS are discussed in the following order: participants, design, independent and dependant variables, and results.

First, authors provide inadequate information on participant verbal behavior or lack stringent inclusion criteria for participants. For example, Frea and colleagues (2001) provide insufficient information regarding participant communication skills prior to intervention. Similarly, studies conducted by Frea et al. (2001) and Malandraki and Okalidou (2007) include participants with a previous exposure to an AAC, which may influence acquisition rates and confound results. Additionally, Magiati and Howlin (2003) excluded sufficient information on the diagnostic system used to classify children with autism and seem to suggest that the *Diagnostic and Statistical Manual of Mental Disorders III* (1980) diagnostic criteria were used, rather the *Diagnostic and Statistical Manual of Mental Disorders IV-TR* (2000).

Methodological issues were present in these examinations as well. A major methodological flaw is using the criterion design alone to demonstrate effects of PECS without conducting a reversal or multiple baseline across behavior to verify experimental control (Frea et al., 2001; Almeida et al., 2005). In these examinations, stability was reached within conditions and met criterion for phase change, however prediction and control over behavior was not verified. Additionally, researchers using group designs

excluded a control group or random assignment to assign individuals to treatment conditions (Magiati & Holwin, 2003). Furthermore, some studies are designated experimental by authors yet on closer inspection are descriptive in nature (e.g., Magiati & Howlin, 2003).

Another issue concerns the influence of PECS on behavior other than verbal behavior. Findings reporting decreased challenging behavior as a function of PECS introduction are often suspect as a result of limited interpretability from the methodological design. These findings emerge from studies in which problem behavior was not analyzed or the procedures utilized to verify that PECS implementation alone may have appeared to decreased problem behavior (Frea et al., 2001; Malandraki & Okalidou, 2007). For example, Frea et al. (2001) changed the opportunities to engage in verbal behavior across experimental phases and used edibles as reinforcers, which combined, may have suppressed opportunities to engage in problem behavior as a function of consumption time.

The last methodological issue regards obtaining appropriate vocal verbal behavior as a function of PECS introduction. Authors report anecdotal data on changes in appropriate behavior (i.e., vocal verbal behavior production) when implementing PECS (Magiati & Howlin, 2003; Malandraki & Okalidou, 2007; Holwin et al., 2007). However, effectiveness and efficacy studies have yet to experimentally verify if PECS produces vocalizations. A more in depth review is provided below (see section entitled “Speech production, generalization, and maintenance”) along with a greater discussion of limitations derived from results of specific studies on speech production.

Regarding independent variables, procedures tend to lack specificity (Heneker & MacLaren-Page, 2003), are modified from PECS protocol without stating a rationale (Frea et al., 2001; Almeida et al., 2005; Malandraki & Okalidou, 2007), and do not specify who implemented PECS (i.e., Almeida et al., 2005). Furthermore, in studies in which the researchers trained teachers to implement PECS, no treatment integrity data are included either during teacher training or following teachers implementing the intervention (Frea et al., 2001; Magiati & Howlin, 2003; Holwin et al., 2007; Carr & Felce, 2007a/2007b). Moreover, the exclusion of treatment integrity appears to be the rule, rather than the exception (Frea et al., 2001; Heneker & MacLaren-Page, 2003; Malandraki & Okalidou, 2007). Surprising as well is the inclusion of modifications to the PECS training protocol without a rationale, which may dramatically impact the results of the study. For example, Malandraki and Okalidou (2007) conducted a preference assessment procedure based on DeLeon, Iwata, and Roscoe (1997) rather than the one specified in PECS manual, and Almeida et al. (2005) presented instructions during phase four, rather than have the participant contact the contingencies of engaging in the correct responses directly.

Also, the selection and measurement of dependant variables appear to be questionable (Frea et al., 2001; Magiati & Howlin, 2003; Howlin et al., 2007) or unclear (Heneker & MacLaren-Page, 2003). For instance, Magiati and Holwin (2003) used rating scales to examine intervention effects rather than measure response rates or percentage of successful responses to opportunities given. Therefore, one is uncertain about how the data were used to inform changes in PECS phases. Another questionable practice concerns the collection of interobserver agreement (IOA). For

example, Howlin et al., (2007) report that IOA was collected for less than 20% of session.

Conclusions based on the results appear to be uncertain as well. Criteria and trends in the data are not specified prior to changing phases (Frea et al., et al, 2001; Heneker & MacLaren-Page, 2003; Almeida et al., 2005; Carr & Felce, 2007a/2007b). This has led researchers to arbitrarily set mastery criterion for phase change that has resulted in a lack of uniformity across studies for changing phases; criterion ranges from 80% (Malandraki & Okalidou, 2007) to 100% during 10 trials in a single session (Almeida, Piza, & Lamonica, 2005). It is unclear if or how such variability may impact the reporting of effectiveness and efficiency findings. One may hypothesize that if mastery criterion is relatively loose, efficiency may increase (i.e., children may acquire phases faster) while effectiveness may decrease (e.g., children show relativity little vocabulary expansion). Moreover, prior to changing phases there seems to be unsystematic variability within the data paths for dependent variables (Frea et al., 2001). Additionally, researchers have collected data via extended observations during one day leading to questions about the reliability of the data (Carr & Felce, 2007a/2007b). Occasionally, treatment data are presented anecdotally in narrative reports (Malandraki & Okalidou, 2007) or via group averages with descriptive statistics on variability omitted (Henekey & MacLaren-Page, 2003). Furthermore, data on generalization (Almeida et al, 2005; Malandraki & Okalidou, 2007) and maintenance are reported anecdotally (Malandraki & Okalidou, 2007). Even when parents are included to promote generalization of PECS effects in other settings, parent retention is low with no explanation given (Magiati & Howlin, 2003), and therefore data are omitted. However,

parents using the system outside of the data collection and treatment implementation settings may impact treatment results. Other data omitted include the specific PECS phases reached following treatment introduction, therefore conclusions cannot be drawn as to the efficiency of PECS implementation (Howlin et al., 2007). The next section will continue the theme of examining the effectiveness and efficiency of implementing PECS, but focus primarily on findings related to comparing PECS to another AAC.

AAC comparisons

One method to examine the effectiveness and efficiency of PECS is to compare it to other AACs. PECS has been compared to sign language (Adkins & Axelrod, 2002; Tincani, 2004), voice output communication aides (VOCAs; Bock, Stoner, Beck, Hanley, & Prochnow; 2005), and Responsive Education and Prelingustic Milieu Teaching (RPMT; Yoder & Stone, 2006a; 2006b). For example, Adkins and Axelrod (2002) used a multi-element design to examine the acquisition, independent use, and generalization of mands trained under PECS and sign language with a seven-year-old male diagnosed with PDD and attention deficit hyperactivity disorder. His expressive language skills consisted of using 3 to 5 signs, 10 to 15 PECS cards, and a few prompt dependant imitated words and phrases. Results show that acquisition rates for PECS consistently required fewer physical prompts to meet criterion (average 7.1) compared to sign language criterion (average 15.7). During conditions in which the same word was taught under each condition, the PECS form required fewer trials and use was more likely to generalize. Furthermore, during generalization probes, data indicate the participant emitted more mands using PECS than sign language. This finding may suggest a preference for PECS over sign language. Other comparisons findings are similar to

those found in this investigation. Limitations to these AAC comparison findings are discussed in detail below.

Limitations of AAC comparisons

This section presents limitations on the research regarding comparing PECS to the above AACs. Specifically, limitations that affect the interpretation of these findings focus on the participant descriptions, experimental design, independent and dependant variables, and the results are presented below.

Similar to other findings, participant descriptions for previously acquired verbal behavior are lacking considerably (Adkins & Axelrod, 2002). Regarding experimental design, no multiple baseline across participants within settings design was used to verify and control the effects of implementing PECS at the level of the individual (Bock et al., 2005). Additionally, Tincani (2004) compared treatments via an alternating treatment design yet did not return to the lesser of the conditions to verify that effects were not due to introducing the interventions in a particular sequence.

Data on the treatment integrity of independent variables were omitted (Adkins & Axelrod, 2002) or if collected, appeared to favor the more subjective of the two approaches (Yoder & Stone, 2006a). Also, procedures for implementing PECS were modified without providing a rationale. For instance, Bondy and Frost (2002) specify that 30 to 40 training opportunities should be given prior to changing phases, while Tincani (2004) provided approximately ten less than the minimum. However, it should be noted that the PECS authors do not specify reasons for including a certain number of opportunities prior to changing phases. Moreover, Adkins and Axelrod (2002) used iconic signs to assist in increasing acquisition rates of mands in their comparison study,

yet provide no evidence that non-iconic signs, such as the sign for “more”, produce lower rates of acquisition.

Concerning dependant variables, authors occasionally lack proper operational definitions (Adkins & Axelrod, 2002) or poorly defined dependant variables in general (Yoder & Stone, 2006a). For example, Yoder and Stone (2006a) define initiating joint attention as an, “intentional communication act about an object that attempts to get the adult to comment, laugh, smile, show attention, or give a label (p. 430).” Additionally, Yoder and Stone (2006a) compared PECS to RPMT using dependant variables that may not apply to the conceptual framework in which PECS is said to operate. When choosing dependant variables, it may be more appropriate to use behavioral dimensions that add objectivity rather than dependant measures that appear to rely on subjective interpretations. Another issue with dependant variables is when authors incorrectly report the verbal operants emitted. For example, Adkins and Axelrod (2002) misrepresent what type of verbal operant was established, stating that a pure mand when in actuality a multiply controlled mand-tact was acquired.

Reviewing results from the above findings, some observations can be noted. For instance, reports of positive changes regarding problem behavior and appropriate vocal verbal behavior were noted, yet were not experimental verified (Tincani, 2004; Bock et al., 2005). Additionally, there is an absence of analysis on the emitted vocal verbal behavior obtained to determine the functional relation of responses (Yoder & Stone, 2006a/2006b). Studies training responses did not include maintenance to provide evidence on the durability of the intervention (Tincani, 2004) or if maintenance was

observed, data were absent on if the treatment was implemented outside the training area to aid in explaining the results (Yoder & Stone, 2006b).

Taken together, research presented in this section suggests tentative empirical support for the use of PECS over other technologies in lieu of the limitations. Although this paper will discuss many factors accounting for the advantages of selecting PECS in the conclusion section of the review, some warrant mention here. First, participants acquire the response topography of PECS more rapidly than manual sign language because of the lack of variability required in responding (i.e., only one form of response is required to emit verbal behavior in selection-based systems). Second, PECS includes portable materials which may promote its use by decreasing response effort, while having behavior contact the reinforcing contingencies more readily as compared with other AAC systems (i.e., VOCA). Third, the training protocol used to teach PECS appears more systematic than others (i.e., RMPT) leading to verbal behavior that is less open to interpretation. These, along with other advantages, may engender PECS as a more suitable and acceptable AAC system to implement with children with autism.

However, one major question regarding the relative effectiveness in comparison studies remains: what is the best way of comparing one treatment to another? Does one examine outcomes, rates of acquisition, maintenance, and/or generalizations data? Is each of these pieces equally valid in stating that one approach is better than another? Or should scientist-practitioners place more importance on social validity of these approaches? Perhaps the answers are context specific. Although, this presents another, parallel issue, what is a fair comparison of approaches? It seems that the scientific community may need to reach some agreement in determining what defines the

features of relative effectiveness in relation to successful action. The next section finishes the review of the effectiveness and efficiency of PECS by a reported collateral effect of PECS implementation: speech production.

Speech production, generalization, and maintenance

Occasionally, studies have obtained speech production following PECS implementation. Researchers often observe speech production following the introduction of a delay to reinforcement procedure during PECS Phase 2 training (Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Ganz & Simpson, 2004; Tincani, Crozier, & Alazetta, 2006). For example, Charlop-Christy et al. (2002) examined the implementation of PECS on speech for three children with ASD who did not speak or rarely spoke. Results show spontaneous speech and verbal imitation for all participants increased during and after PECS training across settings. Additionally, two participants who emitted little to no spontaneous or imitative speech exhibited substantial increases in vocal verbal behavior. Furthermore, collateral effects on appropriate social-communicative behavior increased, while problem behavior for two participants exhibiting tantrums, out of seat behavior, disruptive behavior, and item grabs decreased.

A related issue to observed speech production is the generalization and maintenance of speech. Studies examining generalization have used sequential modification (Kravits, Kamps, Kemmerer, & Poucek, 2002), and train and hope procedures (Tincani et al., 2006). For instance, Kravits et al. (2002) examined the effects of implementing PECS on spontaneous emission of verbal behavior, and the feasibility of the participant's mother, teachers, and peers to use PECS with the child across home and school environments. However, little to no generalization occurred

across environments suggesting the need to program generalization contingencies (see Stokes & Baer, 1977). Additionally, Tincani et al. (2006) attempted to transfer stimulus control to a teacher through her presence during training trials with the experimenter. Tincani and colleagues (2006) found generalization when reinforcement contingencies were in place during the generalization sessions, but not when using a train and hope generalization paradigm. Limitations to speech production findings are identified and discussed below.

Limitations of speech production, generalization, and maintenance

The following discusses the limitations of speech production, generalization, and maintenance findings related to descriptions of participants, experimental design, procedures, and interpretations of results.

Aside from the above reported positive findings on speech production, issues related to participant descriptions exist. For example, Ganz and Simpson (2004) and Tincani et al. (2006) give inadequate descriptions of previous verbal behavior of their participants prior to implementing PECS. A history of verbal behavior acquisition programs and the level of verbal behavior prior to entering programs may influence the outcomes associated with PECS implementation, especially regarding speech.

Methodologically, these studies do not appear to advance the understanding of PECS on speech production beyond the collateral effects reported in previous examinations. For example, Charlop-Christy and colleagues (2002) utilized a multiple-baseline across design to examine vocalizations without examining within participant changes across behavior within the verbal operant class. Similarly, Ganz and Simpson (2004) report phase results that suggest that PECS increases vocalization, yet lack experimental control and do not provide baseline data prior to introducing PECS.

Perhaps by researching vocal verbal behavior through employing a reversal or multiple baseline across behavior design, direct changes in production could be analyzed to validate PECS influence on this phenomenon. Analogously, PECS implementation and speech production may have effects on disruptive behavior, yet only statements about correlated effects can be made due to design limitations (Charlop-Christy et al., 2002).

Another issue concerns the delay to reinforcement procedure used in phase four; some studies use a 10 second delay (Charlop-Christy et al., 2002) while others have found that a 3 to 5 second delay is sufficient (Tincani et al., 2006). This elucidates a possible future direction in the examination of PECS on speech production: the systematic introduction of a delay to reinforcement procedure. Also, within studies, there are inconsistent trial lengths per session (Charlop-Christy et al., 2002) and inadequate rationale behind setting phase change criteria (Ganz & Simpson, 2004). Additionally, monitoring treatment integrity is absent in some studies (Charlop-Christy et al., 2002; Ganz & Simpson, 2004).

Results from the studies lack features that are potentially important for those contemplating PECS implementation to increase speech. Data on utterance length (Charlop-Christy et al., 2002) and on pure mands are reported anecdotally (Ganz & Simpson, 2004). Charlop-Christy et al. (2002) lack maintenance probes on the use of PECS, vocal verbal behavior, and disruptive behavior, while Ganz and Simpson (2004) present these data anecdotally. Additionally, authors assume the function of the emitted verbal behavior based on form rather than the maintaining consequences (Ganz & Simpson, 2004). In addition to speech production findings, limitations related to related to the production of speech outside of the original training context are discussed below.

Attempts to promote generalization parallel limitations of speech production findings (Charlop-Christy et al., 2002). For example, two training protocols (PECS and a social skills training) were implemented simultaneously (Kravits et al., 2002); therefore functional variables cannot be elucidated. Furthermore, when implementing generalization programming, the programming appears to be training the protocol outside the initial training session or training loosely rather than a using an empirically validated method to promote generalization (Kravits et al, 2002; Tincani et al., 2006). Some studies attempted to promote generalization, yet did not present data on generalization (Charlop-Christy et al., 2002), or if presented, did so anecdotally (Ganz & Simpson, 2004). Thus, it is difficult to draw conclusions of PECS effects on speech production outside the training environment due to these limitations.

In total, the studies reviewed in this section on speech production replicate the correlated effects of PECS on speech development with children with autism, yet they have serious methodological flaws limiting the interpretation of data. Occasionally termed a collateral effect, speech production adds an important piece to the social validity of PECS. By broadening available listeners, children with autism may begin producing appropriate vocal verbal behavior that may have other collateral effects associated with its use (i.e., increasing social skills and interactions with peers and adults). Additionally, the area of speech generalization ought to be explored further to elucidate the conditions that evoke speech production and promote generalization. The next section discusses the social validity of PECS implementation as a potential mediating factor of PECS effectiveness and efficiency.

Social validity of PECS implementation

Another important piece that may have implications for effectiveness and efficiency of PECS concerns social validity. One aspect of social validity concerns who implements the PECS protocol. Notably, some of the investigations use educators as the principle agent of change instead of experimenters (Heneker & MacLaren-Page, 2003; Magiati & Howlin, 2003; Howlin et al., 2007). For example, Howlin and colleagues (2007) conducted a randomized and controlled group design to examine the effectiveness of PECS training for teachers of children with ASD. The authors found that PECS teacher training to the specified protocol in the PECS manual produced only modest effects on child communicative behavior. However, the results found appear limited by the lack of treatment integrity data presented.

In addition to the use of educator as implementer, some researchers have inquired on consumer reactions to implementing PECS (Magiati & Howlin, 2003). The inclusion of subjective responses shows recognition for the importance of those implementing PECS as a piece of treatment implementation in educational settings. This aspect of intervention design and implementation may influence the effectiveness and efficacy of the treatment. For example, a practical value questionnaire was administered to teachers to assess their responses about the utility of implementing PECS (Magiati & Howlin, 2003). The comments and ratings were described as highly positive, with many teachers noting that children became more independent and exhibited less problem behavior. This finding suggests that the social validity of the intervention may mediate intervention effectiveness and efficiency. However, as noted below, there are some limitations regarding the social validity findings of PECS implementation.

Limitations of social validity findings of PECS implementation

Although the inclusion of social validity scales suggests that the training and consultation during intervention were agreeable to the consultee (Magiati & Howlin, 2003), yet, a standard method for collecting social validity data remains elusive. For example, Wolf (1978) suggests that the goals, procedures, and outcomes may determine the socially validity of a particular intervention. In contrast, Magiati and Howlin (2003) did not examine the social validity of PECS procedures and outcomes, relative importance of the goals of the intervention from the teachers' perspective, and if the intervention goals align with teacher goals. Aside from these issues, other questions remain about social validity in general: (1) What is the best way to determine the extent PECS is socially valid?, (2) Are maintenance, treatment integrity, and generalization equally important in quantifying social validity or ought these be considered at all?, (3) Are rating scales or observation the most appropriate way to gather social validity evidence? (4) Does social validity vary widely and, if so, is it considerably dependant on context that any universal method cannot be ascertained? and (5) Is social validity necessary? The author agrees that social validity is probably important in applied work, yet has little evidence to suggest that social validity is necessary to evoke sufficient change regarding PECS.

In summary, this section reviewed literature based on the effectiveness, efficiency, and social validity of PECS implementation on verbal behavior. Overall, PECS appears to be adequately effective and efficient for children with autism. Despite the limitations identified in these studies, future directions addressing these limitations point to evidencing and rationalizing PECS use for the treatment of verbal behavior and incorporating experimental methodology to make more definitive interpretations based

on the data. The next section provides a comprehensive summary of PECS research literature and then examines future avenues in PECS research that may strengthen its implementation in school systems.

Comprehensive Summary of PECS Research Literature

Currently, PECS is a behavioral technology that obtains practical results when implemented. Some general findings from the research suggest that first, educational professionals may use PECS in conjunction with other treatment methods, such as with speech therapy techniques, to such an extent that it will, depending partly on student characteristics, facilitate speech development. Second, PECS training focuses on functional communication, teaching verbal behavior in a systematic fashion that facilitates verbal behavior acquisition. Third, PECS requires only one response topography to communicate and one that is not as dependant on dexterous fine motor skills as are sign language and other topography-based approaches (Sundberg, 1993). Fourth, as Bondy et al. (2004) note, early phases of PECS do not require preattentive speech skills such as maintaining eye contact with listeners as with RMPT- PECS simply requires the therapist to create sufficient establishing operations to evoke manding. Fifth, unlike picture pointing systems, in which the individual points to a picture and the caregiver must be attentive to the pointing to observe the mand, a speaker delivers PECS cards directly to the listener. Sixth, as Bock et al. (2005) report, PECS cards are more portable than a VOCA system (weighs less and is physically smaller), thus, decreasing the response effort involved, especially during PECS Phase 2. Finally, individuals who may be naïve to the system may understand PECS cards more readily than manual sign language.

However, there are some disadvantages to using PECS. First, PECS may require more training to implement with integrity than other systems. As mentioned earlier, often those who implement PECS the most are the least trained in the school system. Therefore, a criticism of many studies presented is the use of researchers, not caregivers, teachers, nor paraprofessionals to implement the protocol. Second, the speaker's audience may not effectively respond to PECS as readily as a VOCA (Bock et al., 2005). Third, the visual presentation format may be difficult or impossible to use without modification with certain populations such as students with visual and/or gross motor impairments (Sundberg, 1993). Fourth, the time required to create PECS materials, such as searching for pictures to use, cutting and laminating cards, and creating reusable surfaces to attach cards to can be extensive. In order to address some limitations, future directions in PECS research are proposed below.

Future Directions

In addition to the advantages and disadvantages of implementing PECS, more research on PECS needs to be conducted to experimentally validate findings and allow for greater interpretability of findings. First, PECS research should clarify participant descriptions and inclusion and exclusion criteria for students and implementers, especially regarding participants' previous AAC exposure and extant verbal behavior (Frea et al., 2001; Magiati & Holwin, 2003; Ganz & Simpson, 2005; Tincani et al., 2006; Howlin et al., 2007 Malandraki & Okalidou, 2007). Second, more rigorous experimental methodology must be included to control for confounding variables and to substantiate claims of PECS effectiveness and efficiency (Frea et al., 2001; Magiati & Howlin, 2003; Almeida et al., 2005; Holwin et al., 2007), effects on speech production (Charlop-Christy et al., 2002; Kravits et al., 2002; Magiati & Howlin, 2003; Ganz & Simpson, 2004;

Tincani et al., 2006; Malandraki & Okalidou, 2007; Holwin et al., 2007) and on problem behavior (Frea et al, 2001; Charlop-Christy et al., 2002; Malandraki & Okalidou, 2007) following introduction. Additionally, the same stringent criteria must be applied to research regarding the comparison of one treatment to another in order to elucidate the conditions that allow practitioners to select the appropriate AAC system for students with autism (Tincani, 2004; Bock et al., 2005). Furthermore, criteria for phase changes ought to be standardized at some minimal level and conventional practice for establishing a data trend ought to be used (refer to Kazdin (1982) or Kennedy (2005) for details).

Third, independent variables need greater specificity and monitoring. Varying levels of treatment integrity may systematically affect the results and interpretations of findings, thus ought to be monitored (Adkins & Axelrod, 2002; Frea et al., 2001; Charlop-Christy et al., 2002; Heneker & MacLaren-Page, 2003; Ganz & Simpson, 2004; Rehfeldt & Root, 2005; Carr & Felce, 2007a/2007b; Holwin et al., 2007; Malandraki & Okalidou, 2007; Rosales & Rehfeldt, 2007). Fourth, dependant variables need the same treatment as independent variables, particularly with operational definitions and measurement, and should not be reported anecdotally (Adkins & Axelrod, 2002; Frea et al., 2001; Heneker & MacLaren -Page, 2003; Magiatti & Howlin, 2003; Ganz & Simpson, 2004; Yoder & Stone, 2006a).

Fifth, interpretations of findings from studies appear at times to be overextended, when caution ought to be exercised. This is critical for studies that suggest PECS has a causal effect on vocal verbal behavior and problem behavior. Although, PECS does not appear to decrease or inhibit vocal verbal behavior or increase problem behavior,

questions remain about the causal variables that promote these positive effects and if these effects are related to PECS. Furthermore, there is a lack of evidence to suggest that the effects of PECS acquisition remains durable over time and settings when formal training procedures are discontinued. As seen in the number of studies conducted on PECS and its usage, PECS is an exciting technology that impacts students' behavior in positive ways. Yet claims need evidence to argue PECS effectiveness, and researchers ought to remain critical and cautious of their findings based on experimental methodology. Sixth, within the present studies reviewed, little to no empirical research has been conducted on the fifth and sixth phases of PECS. Phase 5 concerns training intraverbal responding, which includes responding to questions, while phase 6 concerns tacting, including what may be commonly referred to as labeling events or properties of the environment. These two components seem necessary to validate the overall PECS treatment package, yet have been neglected.

Lastly, training educators, including teachers and paraprofessionals ought to be explored in depth. As discussed previously in the review, researchers are often conducting PECS in research, whereas, teachers and professionals are often conducting PECS and other interventions in educational settings. For example, paraprofessionals spend an estimated 47% of their time in delivering instruction and 19% of their time providing behavior support to the students they serve (Giangreco & Broer, 2005). Although paraprofessionals have arguably the most one-on-one contact of educational personnel with a student with autism, paraprofessionals receive little training in interventions that target core student deficits (Giangreco, Edelman, Broer, & Doyle, 2001; Carter, O'Rourke, Sisco, & Pelsue, in press). For example, No Child Left

Behind recommends that states enact minimum qualification standards for instructional paraprofessionals (Carter et al., in press). Minimum qualification standards for instructional paraprofessionals are that they have at least an associate degree from an accredited college and pass a state approved competency exam (Carter et al., in press). However, these minimum qualification standards omit competency standards in working with students in special education who have unique needs, such as students with autism demonstrating functional communication impairments (Giangreco & Broer, 2005). Thus, more research ought to be conducted in training paraprofessionals to implement common interventions that address core student deficits to demonstrate training effectiveness with school personnel.

In sum, investigations need to be conducted on the effects of training educators in PECS. More specifically, research ought to examine if the training model facilitates the correct implementation of PECS outside of training settings (workshops) to the classroom, and second, the impact of teacher and paraprofessional training on student verbal behavior. As mentioned previously, most studies used researchers as implementers who undergo extensive training via PECS workshops and/or conduct PECS after studying the PECS manual. However, when educators are trained in PECS, researchers state that the PECS manual was used for training while not investigating the extent to which PECS implementation was acquired during and after training. This seems to be an important step in examining the social validity of PECS to ensure that those with the most direct contact with students with autism receive and are able to deliver PECS according to protocol.

Although methodological issues exist within the research literature, the reviewed studies preliminarily demonstrate that PECS interventions can increase verbal behavior acquisition in children with autism. Therefore, future research should address methodological issues.

In the next chapter, the paper continues as a study to address issues in PECS training with educators. The study seeks to address methodological issues examining the relationship of training intensity to acquisition of PECS delivery skills by collecting treatment integrity data throughout training, and probing extension and maintenance of training within the classroom to verify durability of the intervention across settings and time. Moreover, the study will provide further demonstration of procedures by replicating results within and across educators. Furthermore, the methods used may prove useful in teaching individuals PECS to carryout PECS research with integrity to address methodological issues found in Holwin et al. (2007).

CHAPTER 2
METHOD

Purpose

The purpose of the current study is to investigate an intervention to teach paraprofessionals the Picture Exchange Communication System (PECS; Bondy & Frost, 2002). Paraprofessionals within the school system typically receive little training in verbal behavior acquisition interventions. However, paraprofessionals are often responsible for implementing curricula due to their assigned role within the school system, and as a result have direct contact with the student with autism throughout the school day. Therefore, students with autism may acquire, generalize, and maintain appropriate verbal behavior more effectively when paraprofessionals are trained to deliver PECS at 100% integrity. Additionally, if successful, the procedures would provide a method to establish a high level of treatment integrity (i.e., 90% or above) for future research.

Participants

Recruitment. Participants were recruited from a Florida public elementary school and a New Jersey early elementary center for students with autism. Recruitment occurred by contacting the elementary school principal or, in the case of the center, the director to schedule a meeting. At the meeting, the trainer presented a synopsis of the research study. The synopsis of the research study provided an overview of the goals, procedures, and time and resource commitments. Following the synopsis presentation, the administrator was asked about paraprofessionals and students in their schools who could potentially benefit from participating. Administrator nominations were used to identify potential adult and student participants who are located in the same classroom

setting, and consent forms were sent to both parents and paraprofessionals simultaneously. Once identified, adult and student participants were screened via a questionnaire to ensure that participants met inclusion criteria.

Adults. Five paraprofessionals were recruited to participate (Table 2-1). Recruited paraprofessionals met the following criteria: (a) had little to no exposure to PECS training or similar verbal behavior training programs (i.e., tact training, mand training) as assessed via questionnaire, (b) earned at least a high school or general equivalence diploma, and (c) were available to participate in sessions three times per week for 10 to 20 min per session. Responses on the questionnaire indicate that all five paraprofessionals completed high school and had some exposure to college courses. Each adult participant had worked with students diagnosed with autism spectrum disorder for at least one and a half years and worked with their target student participant for eight or more months prior to the beginning of the study. Furthermore, years of experience as a paraprofessional ranged from a year and a half to 25 years, and time employed in their current setting ranged from a year and a half to 15 years. Prior to the study, all participants received limited to no training in augmentative and alternative communication packages; even though they had been working with students with autism for a number of years. One participant (Dorothy) did receive “a few afternoon” trainings in American Sign Language through a nationally recognized autism and associated disabilities treatment organization, but had not completed any training in one or more of the verbal behavior programs previously listed. Each paraprofessional was recruited from each student participant’s classroom to increase the likelihood that they would use their acquired skills after the study was discontinued.

Students. Three students, Howard, Walt, and Ted were recruited to participate in the study (Table 2-2). Requirement criteria were used to ensure that the students had the prerequisite skills and availability to participate. Specifically, student participant criteria included the following: (a) limited to no functional vocal verbal behavior, (b) adequate fine and gross motor abilities, and (c) available to participate in sessions three times per week for 10 to 20 min per session. Howard is a 4 year-old boy diagnosed with autism. Before beginning the study, Howard received speech and language therapy for 20 minutes, twice a week, for approximately 5 months in American Sign Language. Howard exhibited no vocal verbal behavior and primarily communicated by hand leading and two to three communication cards. His PECS proficiency level is prompt dependence on PECS Phase 1. Walt is a 4 year-old boy diagnosed with autism. Before beginning the study, Walt exhibited little vocal verbal behavior (one to two word utterances with a vocabulary of approximately five words) and primarily communicated through exchanging communication cards. His PECS proficiency level is PECS Phase 1. Ted is a 7 year-old boy diagnosed with autism. Before beginning the study, Ted exhibited emergent three word utterances functioning primarily as mands, use of an “I want” and use of 50+ communication cards. Ted communicated through a mixture of exchanging communication cards and emitted limited vocal verbal behavior. His PECS proficiency level is proficiency on PECS Phase 4.

Preference Assessment Setting

A location outside the student’s typical classroom setting was used for preference assessment training and implementation. The training area contained two chairs and a table.

Preference Assessment Materials

Before conducting the preference assessment training and implementation, the paraprofessional completed the “Vocabulary Selection Worksheet” (Bondy & Frost, 2002, p. 351) to identify five to ten items that may be reinforcing. Additionally, the information gathered was used to select items to be used during the preference assessment. Protocol sheets with instructions as shown in Table 2-3 were given to paraprofessionals prior to the beginning of each session. Other materials included a stop watch to monitor the duration of the preference assessment, a free operant preference assessment rationale and free operant preference assessment protocol sheets, and a hand held computer and/ or a camcorder to record the duration of student engagement with the items and paraprofessional implementation of the protocol. Additionally, the camcorder was used to record data on the independent (i.e., trainer adherence to the protocol) and interobserver agreement on the dependant (i.e., student engagement and paraprofessional implementation of the preference assessment protocol) variables on at least 25% of sessions.

Preference Assessment Training Procedures

The initial component of the study consists of teaching paraprofessionals to conduct a preference assessment. Preference assessments are designed to gather information regarding materials that may be potentially reinforcing. The PECS preference assessment procedures consist of first identifying five to ten different items that the student seems to like and dislike via the “Vocabulary Selection Worksheet”, observing the student in a free access situation, and then creating a preference hierarchy through a formalized preference assessment. Rather than introduce the later two procedures individually, these procedures were combined. As noted by Bondy and

Frost (2002), the free access situation is a “powerful method to assess [student] preferences” (p. 56), a type of assessment not unlike a free operant preference assessment. Therefore, the “free access situation” was modified to a five-minute free operant trial. The reasons for modifying this procedure were three fold: first, to provide a more structured approach to establish a preference hierarchy; second, to train a preference assessment that maybe acquired expeditiously; and third, to train a preference assessment that could be conducted with relative efficiency as compared with other approaches (e.g., a paired choice preference assessment).

Preference assessment training consisted of a preference assessment overview, role-play, feedback, and observation and feedback sessions. First the trainer conducted the preference assessment overview session. That is, the trainer provided the rationale for conducting the preference assessment, reviewed the free operant preference assessment protocol sheet, and provided an opportunity for the paraprofessional to ask questions about the procedures. Next the trainer conducted the role-play session, whereby the trainer sat across a table facing the paraprofessional and demonstrated the preference assessment protocol with the paraprofessional assuming the role of the student. When the paraprofessional indicated readiness to assume the trainer’s role, then trainer presented the feedback session, assuming the role of the student. During the feedback session, the paraprofessional administered the preference assessment to the trainer, while the trainer provided corrective and positive feedback during and at the end of each trial. Once the paraprofessional implemented the procedure with 100% integrity on one trial, the trainer conducted the observation and feedback session. During the observation and feedback session, the paraprofessional conducted the

preference assessment with the student, while the trainer provided corrective and positive feedback during and at the end of each trial, and recorded the duration of student engagement (defined as touching the item or time consuming the edible). The observation and feedback session continued until the paraprofessional conducted the preference assessment with 100% integrity (i.e., no corrective feedback given) on one trial.

Data were collected on the components correctly performed by the paraprofessional on the free operant preference assessment training data collection sheet. Additionally, descriptive data were collected in a narrative format regarding the questions and answers. As stated above, data were also recorded on duration of student engagement with items. If more than one trial was conduced, the total time engaged with each item across the preference assessment trials was converted to an average duration of engagement to compare engagement of items across trials. Duration data were used to determine which item would be selected as a reinforcer (i.e., the item engaged with for the greatest duration) exchanging a communicative card during PECS Phases 1 and 2.

Preference Assessment Design

The questions asked during the preference assessment are not amenable to experimental evaluation. Thus, the procedure described above simulates a typical training procedure that may be conducted with a paraprofessional, rather than experimentally examining the effect of the procedures to learn the preference assessment. The rationale for conducting this procedure follows that by establishing the preference assessment implementation at 100% integrity, the possibility that extraneous variables may affect PECS preference assessment results may be attenuated, thus

reducing PECS effectiveness by incorrectly identifying potentially reinforcing stimuli.

PECS Training, Extension, and Maintenance Settings

The training setting for Dorothy and Dee was an empty classroom from baseline through observation phases. The training setting for Lucy, Cindy, and Kate was in an office from baseline through role playing phases, and a classroom from modeling through observation phases.

The extension and maintenance environment for Dorothy and Dee was the student's classroom. The extension and maintenance environment for Lucy, Cindy, and Kate was a different office than the one used previously in baseline through role playing phases.

PECS Training Model Materials

Materials consisted of laminated PECS cards (i.e., 5 cm by 5 cm cards with photographic or iconic pictures of stimuli) and high preferred items (e.g., toys, edibles) for each student participant as identified from the preference assessment. PECS cards were available for the student during PECS training and for the paraprofessional throughout all PECS phase conditions. Protocol sheets with instructions were given to paraprofessionals prior to the beginning of each session. A camcorder was used to record independent and dependant variable data.

PECS Training Model Procedures

Following the preference assessment phase, a baseline phase was conducted on PECS Phase 1. Data were collected on the percentage of steps completed correctly by the paraprofessional during each trial. Steps for PECS Phase 1 and Phase 2 are shown in Tables 2-4 and 2-5. After the baseline phase, PECS training began for the PECS phase.

Baseline. During baseline conditions for PECS, trainers presented paraprofessionals PECS related materials to use with the student, including the PECS Phase 1 Protocol or PECS Phase 2 Protocol. Trainers instructed paraprofessionals, “Conduct PECS to the best of your ability,” and the trial began. Trainers terminated the trial if the paraprofessional does not touch the materials for 30 s, reports to the trainer that s/he cannot perform the required task, or correctly completed the final steps of the trial. Note that baseline procedures differ from those of Iwata, Wallace, Kahng, Lindberg, Roscoe, Conners, and colleges (2000) who taught college students to conduct functional analyses by providing the functional analysis protocol following baseline. The rationale behind providing the protocol during baseline was that often individuals have access to instructions (i.e., a PECS manual), yet may not perform treatment procedures correctly.

PECS Training Model

To teach paraprofessionals to implement PECS, a most to least training procedure was used. The training protocol, based on Marcus and colleagues (2001), consists of the following sequentially presented phases: intervention overview, role play, modeling, immediate feedback, delayed feedback, observation, extension, and maintenance. The previous phases are explained below.

Intervention overview. During intervention overview, the trainers discussed the rationale for conducting training and PECS use with students with autism, with attention given on the current PECS phase. Additionally, trainers reviewed baseline data and PECS protocol, and presented the opportunity to ask questions.

Role play. During role play, the trainer role played each intervention component with the paraprofessional assuming the role of the student. After the paraprofessional

indicated readiness to change roles, the trainer assumed the role of the student through the intervention with immediate positive and corrective feedback given at the end of each trial. Upon successfully completing three sessions (three 10 trial blocks) at 100% accuracy of the protocol without immediate corrective feedback, the trainer modeled the protocol with the student.

Modeling. During modeling, the trainer modeled the PECS phase with the student while simultaneously narrating each component of the training protocol with the paraprofessional observing. Modeling sessions continued until the paraprofessional indicates readiness to conduct the protocol with the student when asked.

Immediate feedback. During immediate feedback, the paraprofessional conducted the protocol with the student, while the trainer provided immediate positive feedback on components correctly performed and corrective feedback when necessary at the end of each trial. Trainers terminated the immediate feedback when the paraprofessional completed at least two sessions without corrective feedback (implementing protocol with 100% accuracy).

Delayed feedback. Prior to beginning the delay feedback phase, trainers notified the paraprofessional notified that positive and corrective feedback is delayed until the end of each session. Trainers terminated the delayed feedback when the paraprofessional completed at least two sessions without corrective feedback.

Observation. During the observation phase, the trainer collected data to compare to baseline performance while the paraprofessional conducted the protocol with the student. Trainers did not provide immediate or delayed feedback, nor discussed any events within the session. If during the observation condition, paraprofessionals

incorrectly delivered any step of PECS without 100% integrity, trainers conducted a booster session based on the delayed feedback condition to increase the level of integrity to 100%. Following three sessions, the trainer conducted the extension sessions.

Extension. During the extension phase, the paraprofessional conducted PECS with student in a second setting.

Maintenance. After extension phase, trainers propped maintenance following at least two weeks from the final extension datum point. Trainers collected maintenance in the student's classroom for at least two sessions.

PECS Training Model Design

A multiple-baseline across participants design was used to investigate the effectiveness of a most to least training procedure on paraprofessionals' delivery of PECS with 100% integrity. By establishing PECS delivery at 100% integrity, the possibility that extraneous variables may control PECS delivery, which may reduce PECS effectiveness, may be attenuated. Aligned with single subject design methodology, visual inspection was used to determine a stable data point trend (Kazdin, 1982). Furthermore, criterion to change phases (baseline and teaching procedure phases) was at a least two or more data point trend.

Following training of all participants to integrity on PECS Phase 1, trainers implemented the training model with paraprofessionals in order to train PECS Phase 2. To clarify, trainers reintroduced the PECS training model to train PECS Phase 2 starting from baseline, following the completion of the maintenance probes on PECS Phase 1.

Dependant Variables

The primary dependant variable is the percentage of correct PECS steps

completed per trial. Each session consists of 10 trials. The mean percentage of correct steps per session was plotted on the ordinate, while sessions were plotted on the abscissa. During the baseline phases, steps were scored as correct if they did not occur in order. However, during treatment (both preference assessment and PECS training), paraprofessional responses must have occurred in the correct order to be scored as a correct response. Trainers also collected data on the performance of a sampling procedure prior to each session. The sampling procedure consisted of presenting the student the high preferred stimuli non-contingently for 15 s (if a tangible item) or a small portion (if an edible item) to entice the student.

During Lucy, Cindy, and Kate's baseline sessions, the trainer presented the unusual response one to three times across the session. The unusual response was defined as the trainer reaching for the reinforcer during PECS Phase 1 and 2 step five. The unusual response was included to examine how student response variability influenced paraprofessional PECS delivery. For example, PECS Phase 1 requires that the paraprofessional use an open hand prompt to prepare for the card exchange when the student is reaching for the reinforcer. On the other hand, PECS Phase 2 requires that the paraprofessional does not provide any prompt directed toward the student (i.e., no open hand or verbal prompt). This change in protocol may influence the paraprofessional delivery when an unusual response occurs, thus the data were recorded.

Student percentage of correct responses were probed during paraprofessional implementation of PECS Phase 1 over at least three sessions following the completion of the paraprofessional meeting criterion on the PECS Phase 1. This was done to

ensure that the student was proficient on PECS Phase 1 prior to moving the paraprofessional to PECS Phase 2. Probes were collected during extension and maintenance phases. Student responses are considered the secondary dependent variable because paraprofessional responses determined phase changes. Student responses were collected via videotape probes to examine the effect of paraprofessional PECS implementation on proficiency with PECS.

To summarize, the primary dependant variable is the level of integrity in response to the training procedures, while the secondary dependant variable (a collateral effect) is the student's response to PECS. However, during the modeling condition in the "PECS Training Model" the student is exposed to two different therapists: the trainer and the paraprofessional. The modeling employed could create a threat to internal validity if the goal of the study was to examine student's responses to PECS, not to examine changes in treatment integrity for PECS delivery following the introduction of a training model. Additionally, from the research literature reviewed in "Chapter 1," PECS has been demonstrated to be effective in increasing appropriate verbal behavior for students with autism across multiple studies, thus this was not the primary focus of the study.

Interobserver Agreement

Interobserver agreement (IOA) was collected by having a second observer independently score a session for at minimum 25% of sessions for all participants (range 33.3% to 90.5%). IOA was calculated by dividing agreements in the numerator by disagreements plus agreements in the denominator for each session multiplied by 100% and then averaged over sessions. Criterion for establishing acceptable IOA was set to 80% or above within each condition.

IOA for Dorothy on preference assessment training was collected 100% of sessions and was 100%. IOA for Dee on preference assessment training was collected 50% of sessions and was 100%. IOA for Lucy on preference assessment training was collected 100% of sessions and was 100%. IOA for Cindy on preference assessment training was collected 50% of sessions and was 100%. IOA for Kate on preference assessment training was collected 100% of sessions and was 100%.

IOA for Dorothy on PECS Phase 1 training was collected 46.4% of sessions and was 99.7% (range 97.5% to 100%). IOA for Dee on PECS Phase 1 training was collected 46.7% of sessions and was 99.7% (range 98.8% to 100%). IOA for Lucy on PECS Phase 1 training was collected 38.1% of sessions and was 100%. IOA for Cindy on PECS Phase 1 training was collected 56.5% of sessions and was 100%. IOA for Kate on PECS Phase 1 training was collected 90.5% of sessions and was 100%.

IOA for Dorothy on PECS Phase 2 training was collected 33.3% of sessions and was 100%. IOA for Lucy on PECS Phase 2 training was collected 73.7% of sessions and was 100%. IOA for Cindy on PECS Phase 2 training was collected 66.7% of sessions and was 100%. IOA for Kate on PECS Phase 2 training was collected 50.0% of sessions and was 100%.

Trainer Adherence to Training Protocol

Data on trainer adherence to the PECS protocol were collected via videotape and/or collected when implementing the training protocol by an independent observer to monitor training procedure integrity. Data on training procedural integrity were collected for at least 20% of sessions within a PECS phase. Trainer procedural integrity was calculated by dividing the correct number of steps completed by the total number of steps per trial multiplied by 100% and then averaged across sessions to obtain the

mean percentage of trainer procedural integrity for each PECS phase. If adherence to protocol reduced below 100%, then the trainer discontinued the remainder of the training sessions for the day, reviewed the training protocol, and role-played with the principal investigator until adherence to protocol increased to 100% across two sessions. Trainer adherence to training protocol was maintained at 100% across trainers during the study. Trainer adherence PECS Phase 1 data were collected on 22.2% of Dorothy's sessions, 21.4% of Dee's sessions 38.1% of Lucy's sessions, 56.5% of Cindy's sessions, and 90.4% of Kate's sessions. Trainer adherence PECS Phase 2 data were collected on 44.4% of Dorothy's sessions, 73.7% of Lucy's sessions, 66.7% of Cindy's sessions, and 50.0% of Kate's sessions.

Table 2-1. Paraprofessional participant demographic information

Paraprofessional	Degree	Time as paraprofessional (years)	Verbal behavior training	Working with students with autism (years)
Dorothy	Some college	25	Two afternoon trainings in American Sign Language	15
Dee	Some college	15	No	15
Lucy	Bachelor of Arts in Psychology	1.5	No	1.5
Cindy	Bachelor of Arts in Social Work	2	Informal	7
Kate	Bachelor of Arts in Psychology	3	Informal	3.5

Table 2-2. Student participant demographic information

Student	Age (years)	Primary Diagnosis	PECS Proficiency	Primary Verbal Behavior Topography	Paraprofessional
Howard	4	Autism	Prompt dependent on Phase 1	Hand leading	Dorothy
Walt	4	Autism	Phase 1	Exchanging cards, 10 card vocabulary	Dee
Ted	7	Autism	Phase 4	Emergent three word utterances, I want" strip, 50+ card vocabulary	Lucy, Cindy, and Kate

Table 2-3. Preference assessment protocol

Step	
1	Arranges table with 2 chairs facing each other and across the table from each other.
2	Places stimuli evenly (equidistance) from each other and at the same distance from the student (with the student sitting in the chair opposite from the paraprofessional), ensuring that stimuli are within reach of the student.
3	Has student sample each stimulus by touching manipulatives or eating a small portion of the edibles, saying the action and stimulus name for each stimulus (e.g., “You can play (eat) the car (chips).”)
4	Starts stopwatch and after 5 min, removes stimuli.

Table 2-4. PECS Phase 1 Protocol Components

Step	
Sampling	Prior to first trial of the day, presents reinforcer to student (15 s for tangible/ small piece of edible) as a sample, then begins 1st trial
1	Arranges table with 2 chairs facing each other and across the table from each other
2	Places reinforcers out of reach, but within view of student
3	Places corresponding reinforcer card within reach of student
4	Manipulates or samples reinforcer while looking at student (i.e. if tangible, say “This is fun,” or edible, “mmmmm”)
5	When student is reaching for reinforcer, uses open hand prompt to prepare for card exchange
6	Following card exchange, delivers reinforcer (within ½ second) and brief verbal praise
7	Following reinforcer delivery, removes tangible after 15 s or waits until edible is consumed before beginning new trial
8	Resets environment for next trial within 10 s after tangible is removed or edible is consumed and begins new trial

Table 2-5. PECS Phase 2 Protocol Components

Step	
Sampling	Places two chairs side by side (1) (3) (5) ft away from each other
1	Attaches a single picture in the communication book on Velcro on a third chair
2	Places book (1) (3) (5) feet away from student and communicative partner (triangle consisting of the student, book, and partner as vertices of the triangle)
3	Manipulates or samples the reinforcer while not looking directly at student (i.e. if tangible, say “This is fun,” or edible, “mmmmm”)
4	Does not provide any prompt directed toward the student (i.e., no open hand prompt or verbal prompt such as “Come hear.”)
5	When student hands the card to paraprofessional, takes the card
6	Following card exchange, delivers reinforcer (within ½ second) and brief verbal praise
7	Following reinforcer delivery, removes tangible after 15 s or waits until edible is consumed before beginning new trial
8	Resets environment for next trial within 10 s after tangible is removed or edible is consumed and begins new trial
9	Places two chairs side by side (1) (3) (5) ft away from each other

CHAPTER 3
RESULTS

This study investigated an intervention to teach paraprofessionals the Picture Exchange Communication System (PECS; Bondy & Frost, 2002). As reviewed, PECS has been repeatedly demonstrated in the empirical literature to be an effective augmentative and alternative communication system to establish appropriate functional verbal behavior in children with autism. However, paraprofessionals receive little training in interventions that target core student deficits (Giangreco et al., 2001). Therefore, paraprofessionals may support student achievement through acquiring intervention skills directly related to core deficits of the students they serve. Specifically, investigating a training model to teach paraprofessionals naïve to verbal behavior acquisition interventions may provide evidence to increase learning opportunities for educational support personnel. The current study sought to investigate a training method to train paraprofessionals to delivery PECS with 100% integrity. By acquiring PECS delivery skills, paraprofessionals may benefit students with autism in terms of facilitating the acquisition, generalization, and maintenance of verbal behavior using an empirically based intervention.

The study consists of three parts: (a) preference assessment training, (b) PECS Phase 1 training, and (c) PECS Phase 2 training. The rationale for the preference assessment training was to teach a method of determining items to be used during PECS trainings. During this phase, paraprofessionals training consisted of a preference assessment overview, and role-play, feedback, and observation and feedback sessions. Data were collected questions asked during training and on the percentage of components correctly completed for each session. Note the preference assessment

training was not experimentally investigated, as it is a procedure requiring few responses by the paraprofessional and can be implemented correctly with relative ease.

The PECS Phase 1 and 2 trainings are designed to teach paraprofessionals to correctly and reliably implement PECS with a student diagnosed with autism. The effectiveness of a most to least training model was experimentally investigated using a non-concurrent baseline design across paraprofessionals. Specifically, data were collected on the percentage of steps performed correctly during a trial to examine the model's effectiveness in the acquisition, extension, and maintenance of delivering PECS.

Preference Assessment

Paraprofessionals

Results of the preference assessment baseline probes demonstrated that all participants performed the assessment at 80% or above integrity following preference assessment overview session, at 90% or above integrity on the observation and feedback session, and at 100% integrity on the final trial of the observation and feedback session. Presented below are data regarding each paraprofessional participant.

Dorothy. Following the preference assessment overview session, the paraprofessional asked two questions during the role play session: (a) "What do I do if they [the children] are reaching for the other items during step three?" and (b) "What if they get upset when you take it away?" During feedback session, Dorothy performed the steps with 90% integrity across two trials. On the first trial, corrective feedback was given on step three as a verbal prompt to have the student sample the stimulus. The second trial was completed with 100% integrity. After the feedback session, two

observation and feedback trials were conducted with Howard. During the observation and feedback session, Dorothy completed the preference assessment with 87.5% integrity across two trials. During the first trial, a corrective verbal prompt addressed the use monitoring the stopwatch to terminate the trial after 5 min. The second trial was completed with 100% integrity.

Dee. During the preference assessment overview, Dee asked six questions: (a) “How many items in the preference assessment?” (b) “How many times would you run the preference assessment?” (c) “You wouldn’t try to get them to play with anything?” (d) “Are you engaging them at all?” (e) “When you say do another one, you mean the arrangement?” and (f) “If you have five items, do this [the preference assessment trials] five times?” During the role play session, Dee asked two questions: (a) “He wouldn’t be here yet [referring to setting up prior to conducting the preference assessment]?” and (b) “What happens if they stop playing [with the stimuli]?” During the feedback session, Dee performed the steps with 100% integrity on the first trial. One verbal prompt was presented to address re-locating stimuli to the middle of the table following step two. However, the stimuli were still within reach of the trainer and this information was not a criterion presented on the “Free Operant Preference Assessment Protocol” sheet.

After the feedback session, one observation and feedback was conduced with Walt. Dee completed the preference assessment with 100% integrity during this trial.

Lucy. During the preference assessment overview, Lucy did not ask any questions. During the feedback session, Lucy performed the steps with 100% integrity on the first trial. After the feedback session, one observation and feedback was conduced with Ted. Lucy completed the preference assessment with 100% integrity

during this trial.

Cindy. During the preference assessment overview, Cindy did not ask any questions. During the feedback session, Cindy performed the steps with 100% integrity on the first trial. After the feedback session, one observation and feedback was conduced with Ted. Cindy completed the preference assessment with 100% integrity during this trial.

Kate. During the preference assessment overview, Kate did not ask any questions. During the feedback session, Kate performed the steps with 100% integrity on the first trial. After the feedback session, one observation and feedback was conducted with Ted. Kate completed the preference assessment with 100% integrity during this trial.

PECS Phase 1

The below results describe the effect of the training model on paraprofessional delivery of PECS Phase 1. A non-concurrent multiple baseline across participants was used to assess and verify the effects of training on paraprofessional delivery of steps conduct in a trial. Eight steps were included with each trial and ten trials defined a session.

Dorothy

Baseline. Figure 3-1 top panel shows the results for Dorothy during PECS Phase 1. Baseline data demonstrated that Dorothy correctly completed 69.2% (mean percentage) of PECS phase 1 steps across sessions (range 61.3% to 76.3%). The mean percentage of sampling opportunities completed correctly was 0%. Figure 3-2 shows that the steps completed with 100% integrity across sessions were steps one, two, three, and eight. On the other hand, the steps completed incorrectly or omitted

were steps four (13.3%), five (56.7%), six (60.0%), and seven (23.3%).

Role play. Role play results show that the mean percentage of trials completed correctly across sessions was 99.1% (range 96.5% to 100%). Additionally, all sampling opportunities were completed with 100% integrity. During role play session four, Dorothy completed all steps of each trial correctly, except for steps one, nine, and ten. However, Dorothy implemented each of these steps during session four with 87.5% integrity, incorrectly performing each step once during across all trials within the session. The remaining three sessions were completed with 100% integrity.

Immediate feedback. Immediate feedback data reveal that the mean percentage of trials completed correctly across sessions was 96.8% (range 88.8% to 100%). Furthermore, all sampling opportunities were completed with 100% integrity. The steps completed with 100% integrity across sessions were steps one, two, three, four, and eight. On the other hand, the steps completed incorrectly or omitted were steps five (87.8%), six (98.9%), and seven (87.8%). Following session 12 (the fourth session of immediate feedback), all steps were completed with 100% integrity for the remaining four sessions, except for session 14, when one step on one trial (step seven) was completed incorrectly. Since only one step out of the last four sessions was completed incorrectly (1 step out of 240 PECS steps, excluding sampling opportunities), Dorothy was moved to the delayed feedback training phase.

Delayed feedback. Delayed feedback results reveal that the mean percentage of trials completed correctly across sessions was 99.1% (range 96.3% to 100%). Furthermore, all sampling opportunities were completed with 100% integrity. The steps completed with 100% integrity across sessions were steps one, two, three, four, five,

six, and eight. On the other hand, the step completed incorrectly was step seven (87.8%; a maximum 5 s delay beyond the protocol to remove the tangible). Following session 17 (the first session of delayed feedback), all steps were completed with 100% integrity for the remaining three sessions.

Observation. Observation data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Extension. Extension results show that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Maintenance. Maintenance probe data reveal that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Dee

Baseline. Figure 3-1 middle panel shows the results for Dee during PECS Phase 1. Baseline data demonstrated that Dee correctly completed 96.5% (mean percentage) of steps across sessions (range 86.3% to 100%). The mean percentage of sampling opportunities completed correctly was 16.7%. Figure 3-2 shows that the steps completed with 100% integrity were one, two, six, seven, and eight. In contrast, the steps completed incorrectly or omitted were steps three (98.3%), four (83.3%), and five (90.0%).

On session three, 100% of the steps were completed correctly during the session. With the exception of incorrectly completing step three once on session four (1 step out of 80), baseline sessions five and six were completed correctly. As a result of

100% performance across three of the last four baseline sessions, the PECS overview and model phases were conducted and then the participant indicated that she was ready for the immediate feedback condition. As the baseline session and role play are identical except for the feedback and question and answer components, and Dee completed the baseline sessions at 100% integrity, it was determined that these components did not necessitate conducting the role play phase.

Immediate feedback. Immediate feedback data reveal that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Delayed feedback. Delayed feedback results reveal that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Observation. Observation data reveal that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Extension. Extension results show reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity. However, following the fifth trial of the third session, the trainer cancelled the remaining trials due to severe problem behavior. During the session, Walt exhibited problem behavior in the form of screaming, head hitting, and attempts at hitting Dee. Dee, his teacher, and parents reported increases in problem behavior beginning two weeks previous in the home and at school. Additionally, Dee reported that she was receiving pressure from her teacher about time

commitments. The trainer and principal investigator judged that ethical considerations supported discontinuing PECS training with Dee and Walt and recommended assessment and treatment of problem behavior across settings.

Lucy

Baseline. Figure 3-3 top panel shows the results for Lucy during PECS Phase 1. Baseline data demonstrated that Lucy correctly completed 99.2% (mean percentage) of PECS phase 1 steps across sessions (range 97.5% to 100%). The mean percentage of sampling opportunities completed correctly was 33.3%. Figure 3-2 shows that the steps completed with 100% integrity across sessions were steps one through eight, except once on step five in the first session. Additionally, Lucy implemented the protocol correctly 71.4% of the trials when the trainer presented the unusual response. During the first session, Lucy incorrectly performed step five when the trainer presented the unusual response twice. After the first session, Lucy correctly performed the protocol to 100% integrity when trainer presented the unusual response.

Role play. Role play data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Immediate feedback. Immediate feedback results show that the mean percentage of trials completed correctly across sessions was 99.1% (range 96.5% to 100%). Additionally, all sampling opportunities were completed with 100% integrity. During immediate feedback session one, Lucy completed all steps of each trial correctly, except for steps two (70% correct), five (80% correct), and six (90% correct) in session one. Following the session, all remaining three sessions were completed with 100% integrity.

Delayed feedback. Delayed feedback results demonstrate that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Observation. Observation data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Extension. Extension results show that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Maintenance. Maintenance probe data reveal that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Cindy

Baseline. Figure 3-3 middle panel shows the results for Cindy during PECS Phase 1. Baseline data demonstrated that Cindy correctly completed 88.44% (mean percentage) of PECS phase 1 steps across sessions (range 86.3% to 92.3%). The mean percentage of sampling opportunities completed correctly was 75.0%. Figure 3-2 shows that the steps completed with 100% integrity across sessions were steps one, two, three, four, seven, and eight. Cindy correctly performed steps five on 85% of trials and six on 25% of trials. Additionally, Cindy implemented the protocol correctly 0.0% the trials when the trainer presented the unusual response on step five.

Role play. Role play data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Immediate feedback. Immediate feedback results that the mean percentage of trials completed correctly across four sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Delayed feedback. Delayed feedback results demonstrate that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Observation. Observation data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Extension. Extension results show that the mean percentage of trials completed correctly across four sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Maintenance. Maintenance probe data reveal that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Kate

Baseline. Figure 3-3 bottom panel shows the results for Kate during PECS Phase 1. Baseline data demonstrated that Kate correctly completed 85.8% (mean percentage) of PECS Phase 1 steps across sessions (range 85.8% to 87.5%). The mean percentage of sampling opportunities completed correctly was 0.0%. Figure 3-2 shows that the steps completed with 100% integrity across sessions were steps one, two, and seven. Kate correctly performed steps three on 94.0% of trials, four on 0.0% of trials, five on 96.0% of trials, six on 94.0% of trials, and eight on 98.0% of trials. Additionally, Kate implemented the protocol correctly 80.0% the trials when the trainer

presented the unusual response on step five. Following the session, all steps, except for step four, were completed correctly sessions with 100% integrity.

Role play. Role play data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Immediate feedback. Immediate feedback results that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity, except for the first session when sampling was omitted.

Delayed feedback. Delayed feedback results demonstrate that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Observation. Observation data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Extension. Extension results show that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Maintenance. Maintenance probe data reveal that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Student Responses

With the exception of Walt, Howard and Ted demonstrated PECS Phase 1 proficiency (at or above 90%) across extension and maintenance sessions, meeting

criterion to advance to PECS Phase 2.

PECS Phase 2

Dorothy

Baseline. Figure 3-4 shows the results for Dorothy during PECS Phase 2. Baseline data demonstrated that Dorothy correctly completed 92.5% (mean percentage) of PECS Phase 2 steps across sessions (range 90.0% to 96.7%). The mean percentage of sampling opportunities completed correctly was 100%. Figure 3-5 shows that the steps completed with 100% integrity across sessions were steps one, two, three, four, five, six, seven, and eight. On the other hand, the steps completed incorrectly or omitted were steps four (90.0%) and five (60.0%).

Role play. Role play data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, sampling opportunities were completed with 66.6% integrity. Dorothy omitted the sampling procedure during the first role play session. Dorothy completed the following two sampling procedure opportunities with 100% integrity.

Immediate feedback. Immediate feedback results indicate that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity, except for the first session when sampling was omitted.

Delayed feedback. Delayed feedback results demonstrate that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Observation. Observation data reveal that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling

opportunities were completed with 100% integrity.

Extension. Extension results show that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Maintenance. Maintenance probe data reveal that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Lucy

Baseline. Figures 3-6 top panel and 3-5 shows the results for Lucy during PECS Phase 2. Baseline data demonstrated that Lucy correctly completed 100% (mean percentage) of PECS Phase 2 steps across sessions. The mean percentage of sampling opportunities completed correct was 100%. Additionally, Lucy implemented the protocol correctly 100.0% of the trials when the trainer presented the unusual response on step five.

Role play. Role play data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, sampling opportunities were completed with 100% integrity.

Immediate feedback. Immediate feedback results indicate that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity, except for the first session when sampling was omitted.

Delayed feedback. Delayed feedback results demonstrate that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Observation. Observation data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Extension. Extension results show that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Maintenance. Maintenance probe data reveal that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Cindy

Baseline. Figure 3-6 middle panel shows the results for Cindy during PECS Phase 2. Baseline data demonstrated that Cindy correctly completed 98.1% (mean percentage) of PECS Phase 2 steps across sessions (range 97.8% to 98.9%). The mean percentage of sampling opportunities completed correct was 100%. Figure 3-5 shows that the steps completed with 100% integrity across sessions were steps one through eight, except for step five. Step five was completed correctly 82.5% of trials. Additionally, Cindy implemented the protocol correctly 0.0% of the trials when the trainer presented the unusual response on step five.

Role play. Role play data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, sampling opportunities were completed with 100% integrity.

Immediate feedback. Immediate feedback results indicate that the mean percentage of trials completed correctly across our sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity, except for the first

session when sampling was omitted.

Delayed feedback. Delayed feedback results demonstrate that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Observation. Observation data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Extension. Extension results show that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Maintenance. Maintenance probe data reveal that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Kate

Baseline. Figures 3-6 bottom panel and 3-5 shows the results for Kate during PECS Phase 2. Baseline data demonstrated that Kate correctly completed 100% (mean percentage) of PECS Phase 2 steps across sessions. The mean percentage of sampling opportunities completed correct was 0%. Additionally, Kate implemented the protocol correctly 100.0% of the trials when the trainer presented the unusual response on step five.

Role play. Role play data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, sampling opportunities were completed with 100% integrity.

Immediate feedback. Immediate feedback results indicate that the mean

percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity, except for the first session when sampling was omitted.

Delayed feedback. Delayed feedback results demonstrate that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Observation. Observation data reveal that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Extension. Extension results show that the mean percentage of trials completed correctly across three sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Maintenance. Maintenance probe data reveal that the mean percentage of trials completed correctly across two sessions was 100%. Furthermore, all sampling opportunities were completed with 100% integrity.

Student Responses

Howard and Ted demonstrated PECS Phase 2 proficiency (at or above 90%) across extension and maintenance sessions. Howard demonstrated persistence of PECS exchange to 1 ft and Ted up to 5 ft.

General Summary of Results

Findings indicate that paraprofessionals introduced to a preference assessment acquired and extended responses using a training paradigm to teach skills acquisition. Findings also show that paraprofessionals who had received little to no training in verbal behavior interventions acquired and extended PECS delivery at 100% across both

phases taught. With the exception of Walt's paraprofessional, Dee, who withdrew from the study, paraprofessionals maintained the integrity across environments from at least two weeks from the final extension point. Additionally, paraprofessionals maintained the integrity in the absence of feedback from the beginning of the observation phase until the last conducted maintenance probe for PECS Phase 1, and extended the delivery from the first PECS protocol to the second. In general, the treatment model was successful in establishing and maintaining PECS delivery with naïve participants across people, settings, and time.

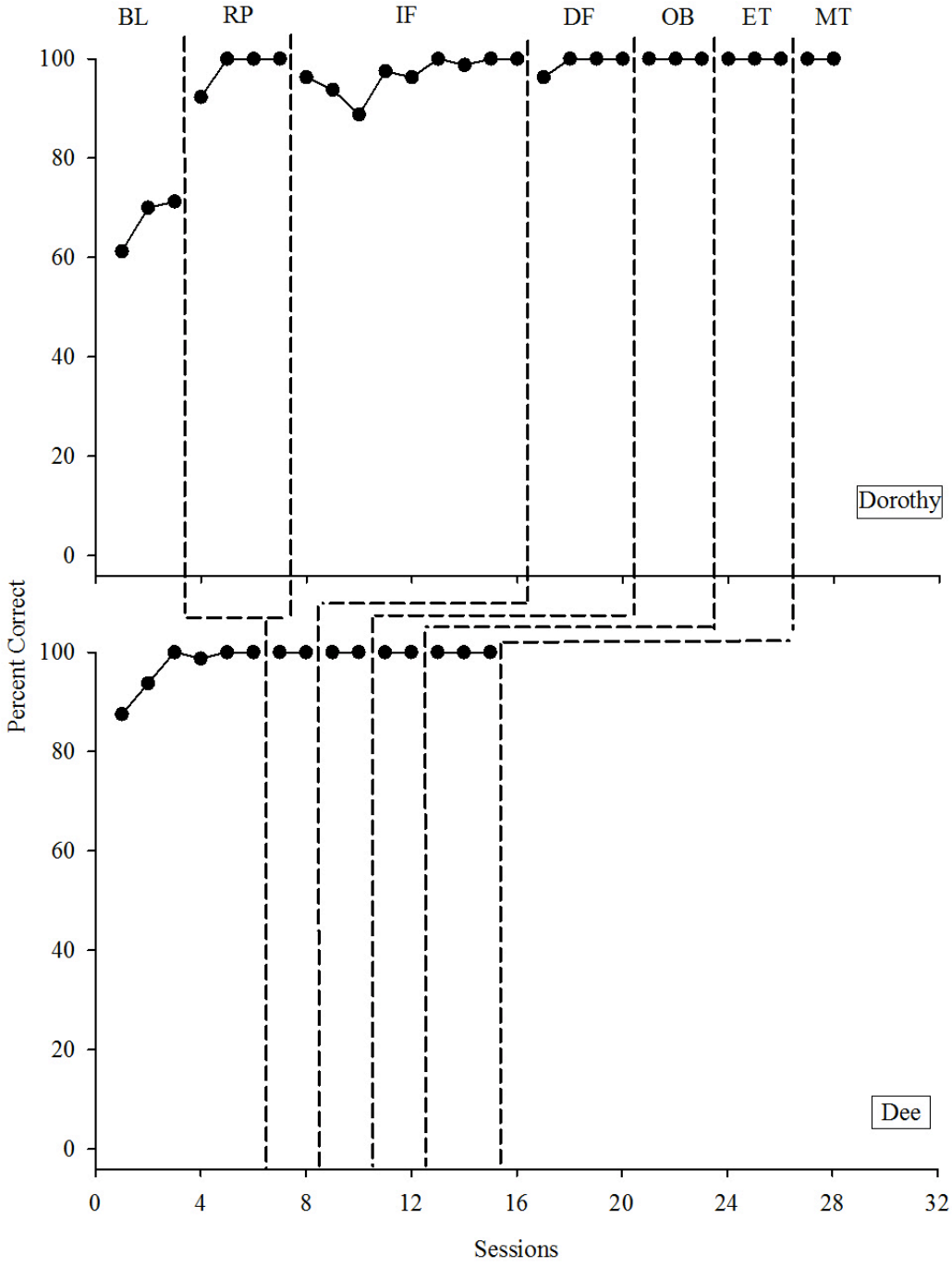

Figure 3-1. PECS Phase 1 Training: mean percentage of correct trials completed per session across baseline (BL), role play (RP), immediate feedback (IF), delayed feedback (DF), observation (OB), extension (ET), and maintenance (MT) phases for Dorothy (top panel) and Dee (bottom panel).

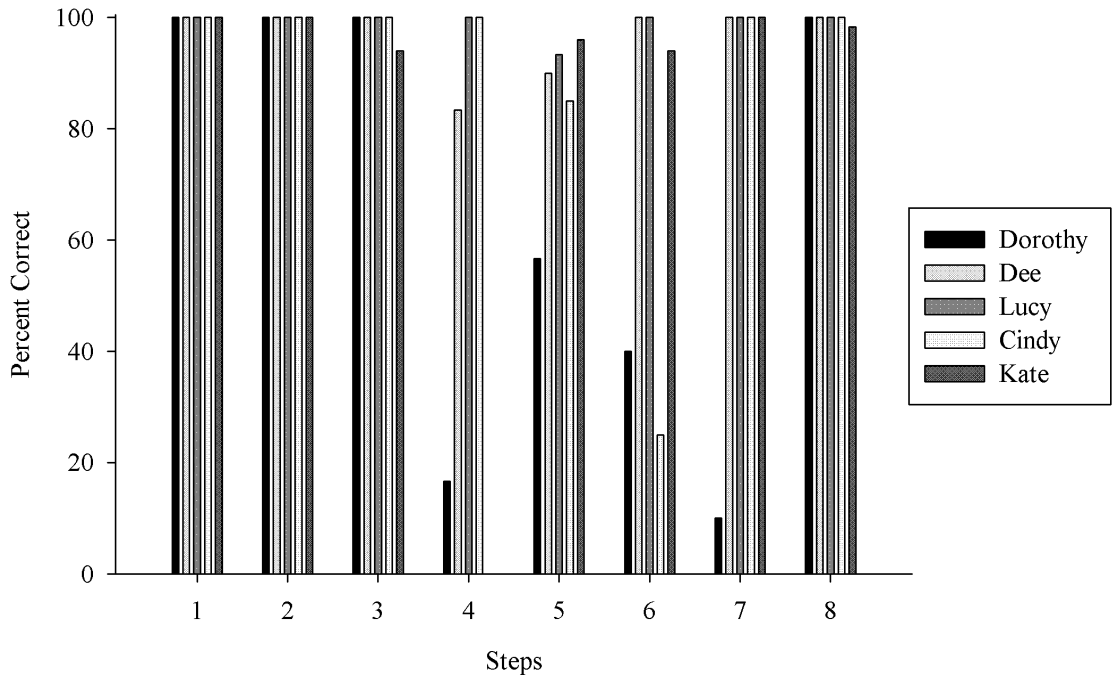

Figure 3-2. PECS Phase 1: mean percent of a step performed correctly during baseline.

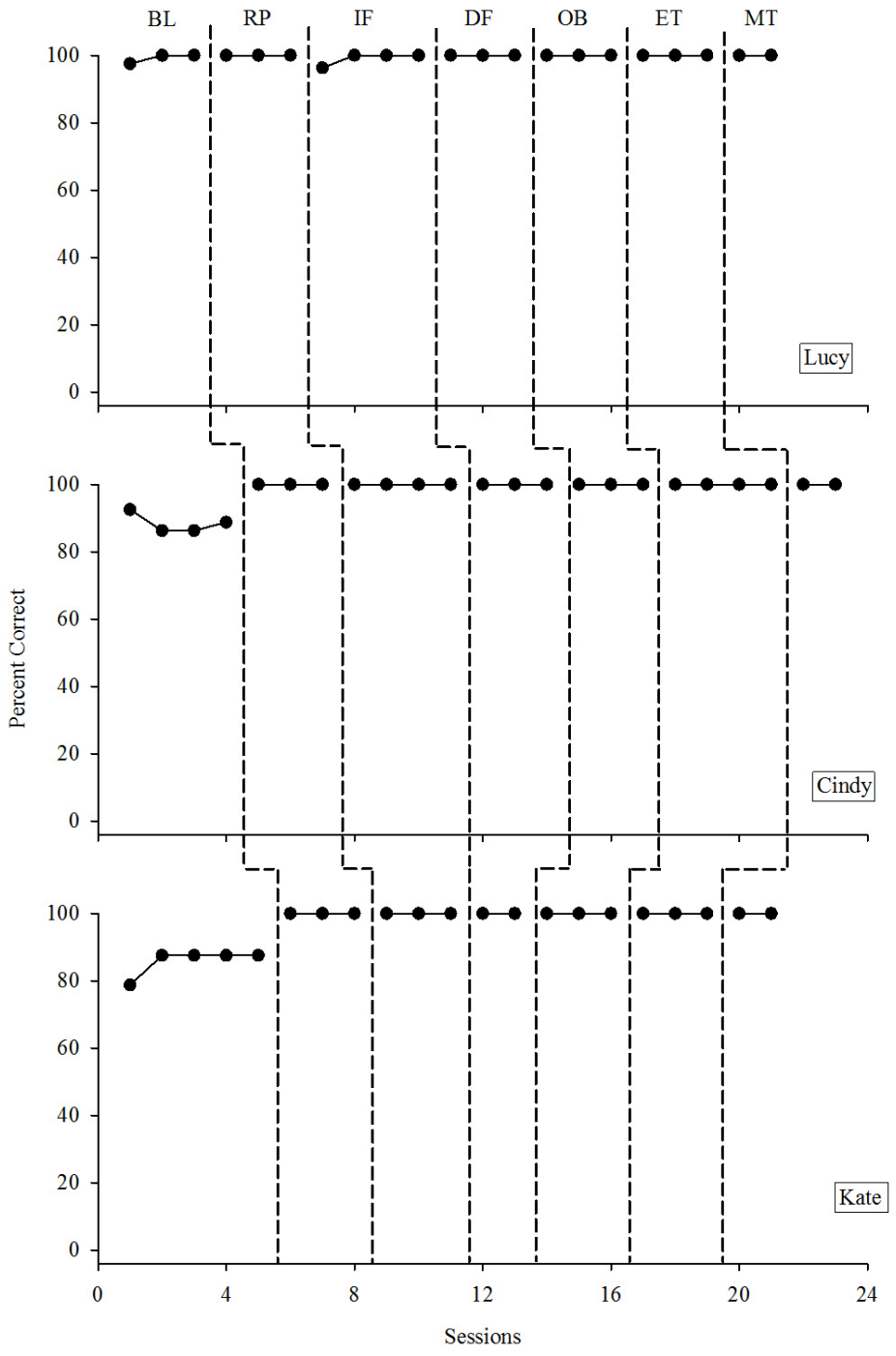

Figure 3-3. PECS Phase 1 Training: mean percentage of correct trials completed per session across baseline (BL), role play (RP), immediate feedback (IF), delayed feedback (DF), observation (OB), extension (ET), and maintenance (MT) phases for Lucy (top panel), Cindy (middle panel), and Kate (bottom panel).

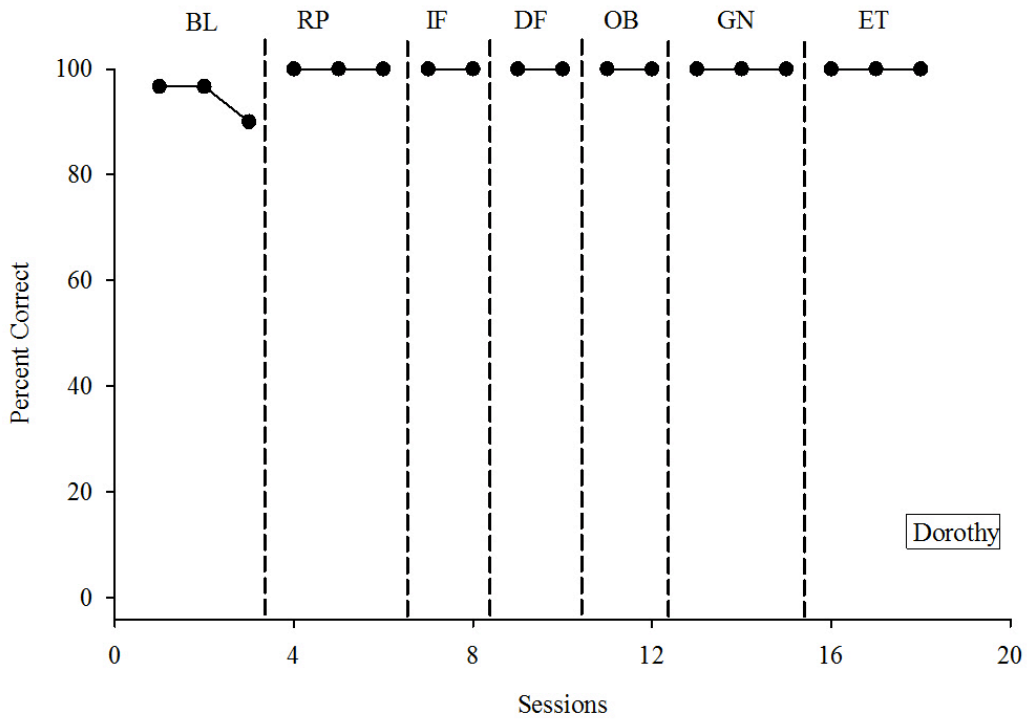

Figure 3-4. PECS Phase 2 Training: mean percentage of correct trials completed per session across baseline (BL), role play (RP), immediate feedback (IF), delayed feedback (DF), observation (OB), extension (ET), and maintenance (MT) phases for Dorothy.

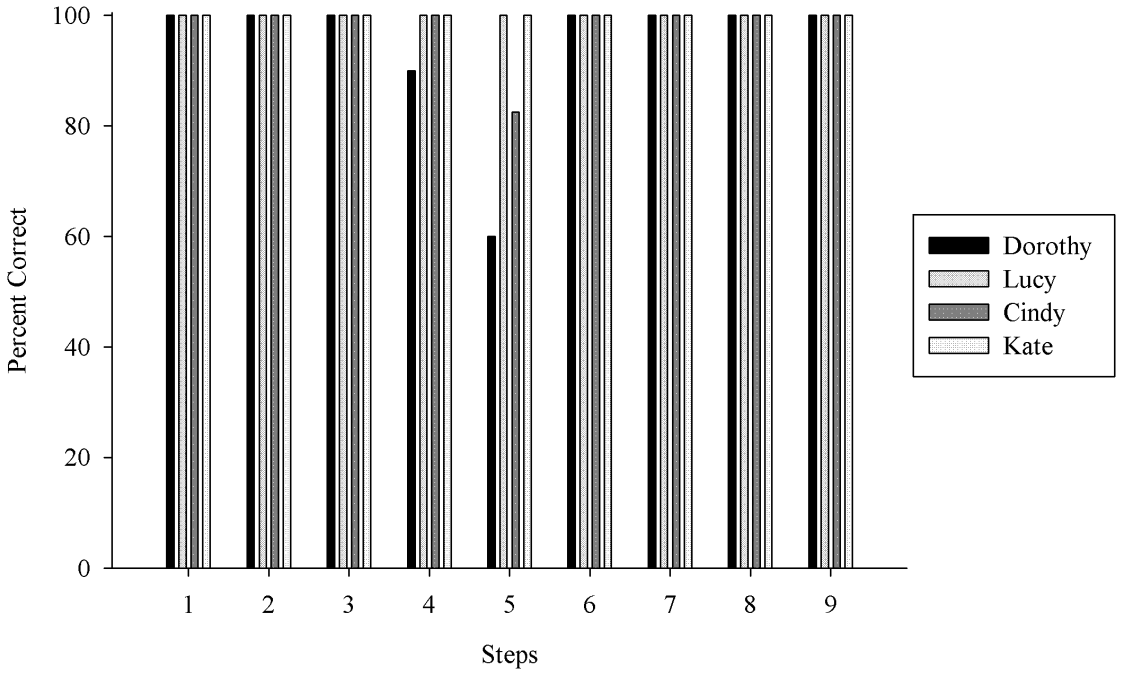

Figure 3-5. PECS Phase 2: mean percent of a step performed correctly during baseline.

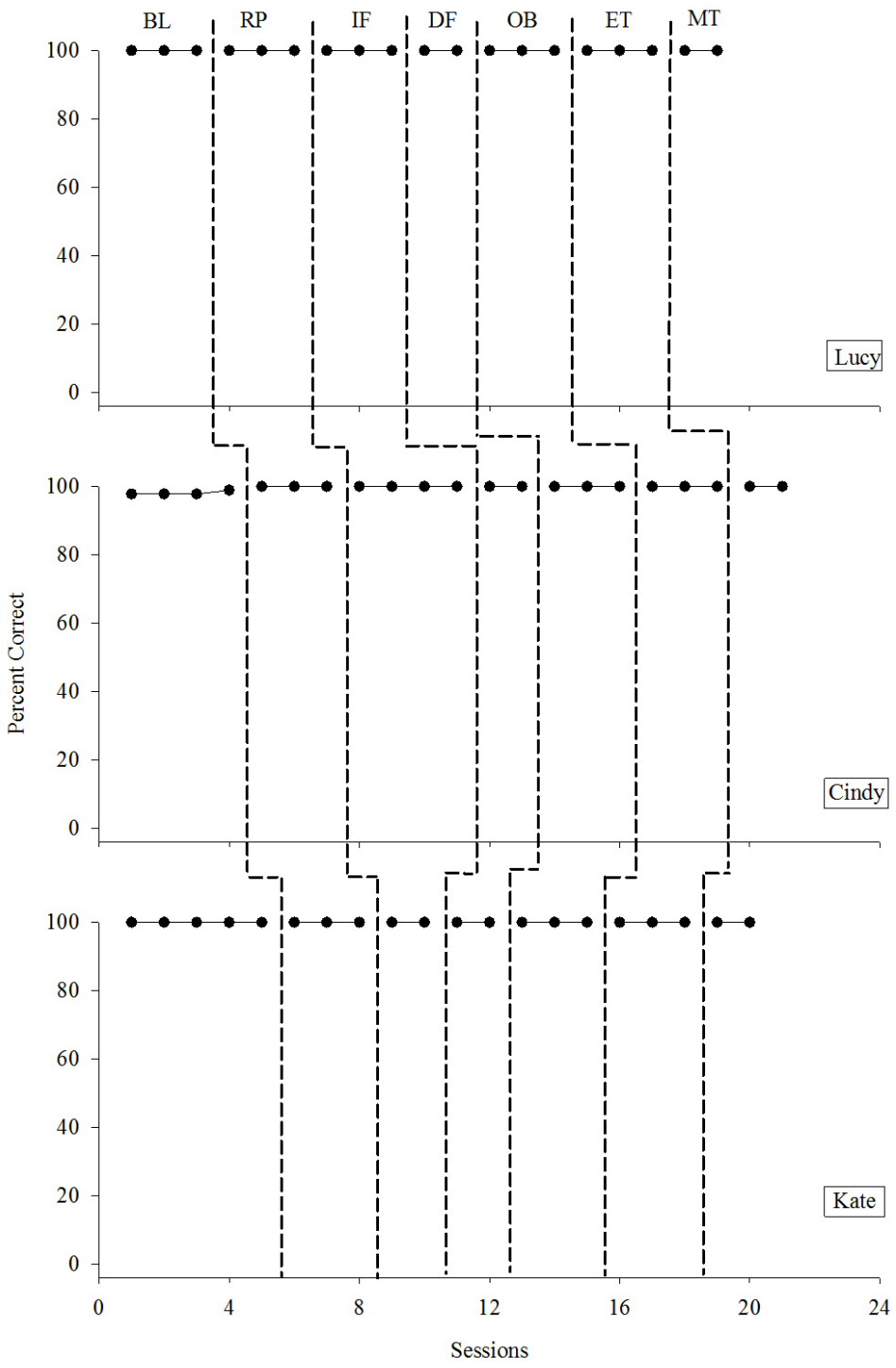

Figure 3-6. PECS Phase 2 Training: mean percentage of correct trials completed per session across baseline (BL), role play (RP), immediate feedback (IF), delayed feedback (DF), observation (OB), extension (ET), and maintenance (MT) phases for Lucy (top panel), Cindy (middle panel), and Kate (bottom panel).

CHAPTER 4
DISCUSSION

Summary of Purpose

Functional communication deficits are a defining criterion for diagnosing autism (American Psychiatric Association, 2000) and one of the most important challenges for professionals who provide services in this area. One technology created for the purpose of addressing functional communication deficits in students with autism is the Picture Exchange Communication System (PECS; Bondy & Frost, 2002). PECS is an augmentative and alternative communication system created and empirically validated to facilitate the acquisition of appropriate and functional verbal behavior in students with autism.

One subset of educators providing direct educational support to students with autism is paraprofessionals. Paraprofessionals spend an estimated 47% of their time in delivering instruction and 19% of their time providing behavior support to the students they serve (Giangreco & Broer, 2005). Although paraprofessionals have arguably the most one-on-one contact of educational personnel with a student with autism, paraprofessionals receive little training in interventions that target core student deficits (Giangreco et al., 2001; Carter, O'Rourke, Sisco, & Pelsue, in press).

The purpose of this study was to investigate a training model to teach paraprofessionals who were naïve to verbal behavior acquisition interventions to implement PECS. Through validating a model that is cost effective to introduce and implement, and successful at training paraprofessionals, the study may provide supportive evidence to advocate increasing learning opportunities for educational support personnel. That is, providing opportunities to the most likely interventionists in

most school settings using an empirically validated training model to teach empirically validated interventions to more efficiently and effectively educate students they support.

To validate the model, the study sought to investigate a training method to train paraprofessionals to deliver PECS with 100% integrity. The training method used was designed to systematically fade support of the training as the paraprofessional demonstrated competency (i.e., PECS implementation at 100% integrity) in delivery PECS. By acquiring the skills necessary to implement PECS, paraprofessionals may benefit students with autism in terms of facilitating the acquisition, generalization, and maintenance of verbal behavior using an empirically based intervention.

Additionally, by validating the model and providing evidence for its use with PECS in establishing a high level of treatment integrity, others may adopt the procedures for future research with PECS and other verbal behavior intervention technologies. For example, researchers may use the model to examine the effects of PECS with other verbal behavior interventions, or empirically examine other verbal behavior interventions to support or improve their effectiveness for practitioners. Through employing validated treatments, practitioners align themselves with best practice of using empirically based interventions to better support the students they serve (National Association of School Psychologists, 2000).

Summary of Findings

In order to investigate the effectiveness of an intervention to teach paraprofessionals to implement PECS, this study recruited paraprofessionals previously unfamiliar with PECS and assessed their educational background, history employed as paraprofessional working with children with autism, and training in verbal behavior interventions for students with autism. Although paraprofessionals reported an

extensive and varied educational background (ranging from some college experience to completion of a post-secondary degree in early childhood education) and a vast cumulative experience in working with children with autism (ranging from 1.5 years to 15 years), they had received little to no training in verbal behavior interventions to intervene on core deficits.

Paraprofessionals were informally trained to conduct free operant preference assessment in order to identify stimuli to incorporate during PECS training. Training consisted of an overview of the preference assessment, role-play, feedback, and observation and feedback sessions. Paraprofessionals performed the preference assessment with 100% integrity after a maximum of two feedback sessions. Furthermore, paraprofessionals generalized the acquired preference assessment skills to the student during the observation and feedback sessions with 100% integrity. The study appears to be the first on PECS training to include data on preference assessment training, demonstrate extension of skills to the student, and provide a rationale for conducting a modified preference assessment (Malandraki & Okalidou, 2007).

The primary results of the study suggest that paraprofessionals naïve to verbal behavior interventions, acquired and generalized PECS delivery at 100% across both phases taught. With the exception of one paraprofessional, Dee, who withdrew from the study, paraprofessionals maintained the integrity of the training across environments from at least two weeks from the final extension point. Additionally, paraprofessionals maintained the integrity in the absence of feedback from the beginning of the observation phase until the last conducted maintenance probe for PECS Phase 1, and

generalized the delivery from PECS Phase 1 to PECS Phase 2. In general, the treatment model was successful in establishing and maintaining PECS delivery with naïve participants across people, settings, and time.

The discussion below is organized into three major areas: professional developmental, service delivery, and training methodology. First, in the professional development area, a call for training paraprofessionals is discussed. Then, in the service delivery area, the implications of finding generalization across training protocols and setting treatment integrity criterion levels are discussed. Finally, in the area of training methodology, the implications of collecting paraprofessional baseline responses on specific steps, presenting data throughout training phases, fading support while maintaining PECS treatment integrity, and the time required to train paraprofessionals is discussed. Following these sections, limitations of the study and future directions of the research are discussed.

Professional Development

Need for Paraprofessional Training

The paraprofessionals in the study were recruited because they met the criteria of having limited to no training in verbal behavior interventions and working directly with students with autism who exhibited functional communication impairments. It was remarkable to discover that all of the paraprofessionals had been working for at least one year with students with autism and yet had not received training on a critical area of student need. The study demonstrated that paraprofessionals respond positively to the training procedure, and findings support the utility of individualized training to meet the needs of students they serve. Furthermore, the training procedure is especially cost-effective because it does not require any special materials found outside the classroom

setting. Additionally, the model can be conducted without the expense of sending paraprofessionals to workshop training, a particularly important consideration for school districts with significant budgetary constraints.

Service Delivery

Generalization Across Training Protocols

The training procedure resulted in paraprofessionals generalizing acquired PECS delivery across individuals and settings. With the exception of Dorothy's and Lucy's performance slightly decreasing when initially performing PECS Phase 1 with the student, paraprofessionals' delivery generalized across individuals (trainer to student) from the role play to immediate feedback phase, and settings.

An interesting finding observed in the study was the generalization of acquired behavior across PECS Phases. In the acquisition literature this is referred to as a "savings" or a "savings effect." A savings effect is defined as the reduction of training trials to mastery relative to previously acquired material (Cuvo & Riva, 1980, p. 322). The authors conceptualized savings as a transfer of training with the additional component of acquisition efficiency. When paraprofessionals were introduced to PECS Phase 2, baseline results indicated that more steps were performed correctly compared to PECS Phase 1 baseline. This observed savings effect might discount possible concerns about rigidity to the protocol both within and across PECS phases. For example, the training protocol may establish responses only to situations that are similar to those observed during training with the trainer. However, it was observed that during Phase 2, Cindy waited over 12 min with Ted repeatedly attempting to take the item before the PECS exchange occurred. One way to determine if behavior was more rule-governed (following the protocol) or contingency-shaped would be to vary the

contingencies as the protocol remained the same to examine if behavior is controlled by instructions or the contingencies (see Hayes, Brownstein, Zettle, Rosenfarb, & Korn, 1986).

Setting Treatment Integrity Criterion Levels

When the level of treatment integrity criterion is set in a study, treatment integrity criterion levels appear to be set arbitrarily. That is, treatment integrity criterion may be established at 80% or 90% without an explanation. However, treatment integrity levels are established to monitor the precision to which experimental procedures are conducted (Baer, Wolf, & Risely, 1968; Kennedy, 2005). As noted in a review of articles of school-based interventions with children appearing in the *Journal of Applied Behavior Analysis* by McIntryre, Gresham, DiGennaro, and Reed (2007), limited information is known about specific variables that may determine which interventions remain insensitive to varying levels of treatment integrity (i.e., time-out; Northup, Fisher, Kahng, Harrel, & Kurtz, 1997) while other treatments are compromised (i.e., differential reinforcement of alternative behavior; Vollmer, Roane, Ringdahl, and Marcus, 1999). Within PECS research, treatment integrity monitoring is often omitted (Frea et al., 2001; Heneker & MacLaren-Page, 2003; Magiati & Howlin, 2003; Malandraki & Okalidou, 2007; Holwin et al., 2007; Carr & Felce, 2007a/2007b). For example, Holwin and colleagues (2007) reported modest student outcomes and maintenance without reporting treatment integrity data. The authors' findings contradict previous research demonstrating positive student PECS outcomes while claiming that PECS, rather than a lack of treatment integrity, resulted in student outcomes. Without treatment integrity data, it remains to be seen as to whether varying treatment integrity during training affects student outcomes. However, it is possible that reported failures in verbal

behavior acquisition (e.g., Howlin et al., 2007) may be due to failures in treatment implementation rather than the well-established PECS protocol, as evidence is more supportive of the former than that latter hypothesis. At this point, this is a working assumption and more research is necessary to determine the effect of differing levels of integrity on skill acquisition, including acquisition of PECS.

In the current study, the criterion to change phases was set at 100%. The rationale for setting the criterion at 100% integrity is that if paraprofessionals have demonstrated mastery of the protocol, they ought to perform all steps of the protocol with 100% integrity consistently enough to inoculate against treatment drift (DiGennaro, Martens, & McIntyre, 2005; Noell, Witt, LaFleur, Mortenson, Ranier, & LeVelle, 2000). As discussed previously, recording and presenting only the percentage of correct steps omits a closer examination of which steps may be the most critical for skill acquisition. On investigation researchers may find that not all steps are created equally. Unless a system is devised to weight the various steps according to importance by a certain measure, the levels of criteria will continue to remain arbitrary. However, if student responses to the protocol remain similar to when treatment integrity varies within a step, then this may be a moot point. Although the difficulty with this choice is that other steps may be compromised in favor of training loosely, leading to diminished returns. Thus, a more conservative approach would be to establish mastery at 100%, which was the approach used by the present investigation. From this point, future studies could then empirically investigate varying levels of treatment integrity.

Training Methodology

Collecting Paraprofessional Baseline Responses on Specific Steps

Interestingly, this examination showed that paraprofessionals omitted or incorrectly performed the steps that appear critical for students to learn PECS and involve responding directly to student behavior during PECS Phase 1 and Phase 2 baseline phases. For example, in PECS Phase 1 baseline, paraprofessionals often did not provide the open hand prompt to prepare for the card exchange. With this step, the student exchanges the card and receives reinforcement. Furthermore, the card exchange establishes the form of manding under PECS and is used throughout PECS Phases 1, 2, and 3. Hence acquiring this step appears more important than step one in which the paraprofessional arranges the environment correctly. When data are collected on the omitted or incorrectly performed responses, it becomes possible to tailor training to specific steps, rather than the reintroduce training to the entire protocol. By organizing training around specific steps missed, training may be conducted more efficiently.

A unique feature of the study of the study was the inclusion of a trainer delivered unusual response during Lucy, Cindy, and Kate's baseline phases. The unusual response was used to simulate occasions when a student would reach for a reinforcer directly rather than engage in the card exchange (i.e., the correct student response to PECS delivery), and set the occasion for paraprofessional performed open hand prompt. As verbal behavior is defined as "behavior reinforced through the mediation of another person's behavior (Skinner, 1957, pp. 1-2)," the inclusion of an unusual response examined how the paraprofessional would respond to situations in which the student response may short-circuit socially mediated contingencies. Although in these

situations the student may increase independence by obtaining reinforcers directly, the increase usage of these types of responses may result in maintaining communication deficits and associated problem behavior. This inclusion of an unusual response during behavior skills training may prepare paraprofessionals to appropriately respond to behavior exhibited by students that is unexpected.

Presenting Data Throughout Training Phases

One aspect of this study that differs from previous studies is presenting data occurring throughout each training phase rather than presenting only pre-treatment, post-treatment, and maintenance data (i.e., Sarokoff & Sturmey, 2004). By presenting data throughout the training phases, practitioners can be informed as to how many sessions participants were exposed to during each phase, how participants responded to changes in phases when students replaced the therapist and when feedback was faded. For example, it was revealed that performance training from the role play phases to the immediate feedback phases did not generalize at 100% integrity. This an important finding considering that during workshop trainings, the trainee may role play with another adult and receive feedback, thus acquiring a certification on a particular intervention, without ever having the opportunity to receive feedback when working directly with students.

Additionally, with some behavioral skills training packages, it is unclear how the training impacts performance throughout training when data consist of pre- to post-treatment phase summaries. One potential reason for this type of data presentation is that trainings often include many components introduced simultaneously as a package. For example, Sarokoff and Sturmey (2004) appear to introduce role playing, and positive and corrective feedback simultaneously. However, this type of data

presentation obscures the role each component of the intervention (e.g., role playing alone or positive feedback alone) of the intervention package. That is, when pre and post training data are presented, authors neglect to report the number of sessions or trials conducted to reach a mastery criterion, thus omitting information regarding the efficiency of training. Overall, omitting this information may impact the social validity of the procedures in determining if the costs associated with investing time, money, and other resources are worth the outcomes of training (Wolf, 1978).

Fading Support While Maintaining PECS Treatment Integrity

In addition to extension, maintenance of delivery was observed across participants and across PECS Phases following at least two weeks from training termination. One finding from the Howlin et al. (2007) investigation was that once periodic consultation was removed, the effects on PECS usage did not maintain. One possible reason that PECS usage decreased was that those implementing training did not contact the contingencies to maintain PECS delivery. Thus, the authors found only modest effectiveness of PECS teacher training and periodic consultation on student outcomes. Alternatively, positive effects of implementing the current training protocol were the durability of training effects through time when systematically fading support to establish independence. One possible caveat is that maintenance was not investigated without the presence of the trainer, thus observer reactivity may have influenced the implementation of the protocol.

Time Required To Train

The basic PECS workshop offered by Pyramid Educational Consultants occurs over two days for approximately seven hours per day (if one hour is allocated for a lunch break; Pyramid Educational Consultants, 2010). During the workshop, trainers

present the historical overview of PECS, introduce and demonstrate all six phases of PECS, and provide opportunities to role play. During the current study, paraprofessionals were informally trained to conduct a preference assessment, assessed on PECS Phase 1 and 2 delivery during baseline, presented an overview and rationale for PECS for phase taught, provided opportunities to role play, ask questions, and receive feedback. Taking a conservative estimate by assuming that the preference assessment required 20 minutes to train and each PECS training session averaged five min in length, the study's duration for the participant with the maximum number of sessions (Dorothy) was 4 hr and 10 min. Therefore, it may be that the sufficient amount of time to establish 100% treatment integrity across the six phases of PECS using this model is less than the two day workshop training. That is, the study examined the acquisition of PECS utilizing a systematic method of fading trainer support with the paraprofessional. For clinical application, eliminating the number of baseline sessions presented, the number of trials in a session (as each session contained 10 trials), and reducing the number of sessions for mastery, the amount of time for training may be substantially decreased. For example, data show that Lucy, Cindy, and Kate demonstrate a high level of treatment integrity during the PECS Phase 2 baseline condition. This finding may support conducting a probe in the immediate feedback with the student when treatment integrity is at 100% during the baseline session, and if 100% treatment integrity is observed during the probe, moving directly to the observation or extension phase. Therefore, the total amount of time appears to be less than the total time at the workshop, with the additional component of demonstrating mastery of PECS compared with receiving a certificate of attendance presented at the

PECS Basic Training at the two-day workshop (Pyramid Educational Consultants, 2009).

The reduced amount of time may suggest that the model is more efficient at establishing PECS delivery without compromising effectiveness. The difference between the current study and that of a workshop is the training format. The present model was introduced in a one-to-one format with the trainer and paraprofessional, and training with a student. Additionally, trainings occurred over multiple days, rather than a 2-day 14 hr workshop dose. The results of the study implicate that trainings which occur in smaller doses, over longer time periods may produce better maintenance outcomes than those of workshop trainings. However, more research evaluating format effects, such a group size and time span of training, is required to make more definitive conclusions.

Limitations

In light of the current findings, there are limitations that ought to be considered. Seven limitations will be discussed. First, some experimental control was lost when paraprofessionals were introduced to the PECS Phase 2. Specifically, generalization was observed from the PECS Phase 1 protocol to Phase 2 protocol. Although, for clinical purposes this finding is desirable, generalization across protocols compromised experimental control. Second, occasional violations occurred in establishing a stable three-point trend in favor of a stable two data point trend to change between training phases. Third, baseline sessions were conducted with the trainer not student. By not conducting the training with the student participant, a false baseline of performance may have been established. Fourth, the control dyad for paraprofessional Dorothy was Dee. Therefore, extraneous factors could account for her performance during PECS Phase 1

maintenance and Phase 2 training. However, by collecting trainer adherence to the protocol and replicating the effects of training across other participants, data support that Dorothy's responses authentically represent training effects. Fifth, student proficiency with PECS varied. Student proficiency ranged from prompt dependence on PECS Phase 1 to Phase 4. Since proficiency varied, student responses to the paraprofessional behavior may have altered the efficiency with which the training occurred. For example, Dorothy's student participant was Howard. Howard entered the study exhibiting prompt dependence on PECS Phase 1. Compared to Howard, Ted entered the study working on PECS Phase 4. Howard's relatively lower level of proficiency with PECS may have contributed to Dorothy's slower acquisition of PECS during the immediate feedback phase of PECS Phase 1. Six, the study did not examine the distinction between "necessary" versus "sufficient" components of the training sequence. For instance, delayed feedback was sufficient to maintain PECS delivery at 100%, but it is unclear if the phase was necessary when following the immediate feedback condition. However, determining the necessary components may not be socially significant because of the relatively short time to complete the training model phases. Seven, observer reactivity may have contributed to maintenance following training termination.

Future Directions

In general, future research should investigate different methods to train staff members. That is, future investigations of various staff training programs would provide important information on the best methods to train staff members as well as the necessary and sufficient components for long-term extension and/or generalization, and maintenance of skills. For example, the current investigation used a most to least fading

procedure to train PECS. However, future studies could evaluate the effect and efficiency of using different types of fading procedures (i.e., most to least, least to most) on PECS implementation. Further, investigations along this research line may assist trainers in determining the focus training (i.e., training efforts allocated to incorrectly performed steps as compared with all steps) and how much support is required to train paraprofessionals. A similar theme is to investigate the use of immediate as compared with delayed feedback. The current study introduced immediate feedback following the trial and delayed feedback after the end of each session. However, it is unclear what is more effective. That is, does a delay that occurs after every step, trial, or at the end of each session, or at the end of the days sessions increase the effectiveness and efficiency of training?

The utility of examining training loosely to protocols ought to be further examined. For instance, it is possible that training loosely allows for less rigidity and greater generalization to other protocols. Similarly, training loosely may result in paraprofessional behavior that more effectively responds to situations that do not arise during training. However, training loosely may result in low levels of treatment integrity for a specific protocol. Therefore, future investigations should assess the effects of various training methodologies on skill acquisition, maintenance, and generalization of skills.

One interesting area of investigation is the examination student PECS proficiency differences on paraprofessional acquisition. If a student is proficient with the PECS phase training, does the student's behavior provide sufficient feedback to correct deviant paraprofessional responses? For example, a student-paraprofessional dyad

consisting of a student proficient at PECS Phase 1 may provide subtle prompts evoking the paraprofessional to use the open hand prompt. Furthermore, does training with a PECS proficient student increase paraprofessional PECS generalization to students who are less proficient with that particular PECS phase? Findings from these types of studies may suggest other routes to increase the effects of training beyond what is explicitly taught.

Other aspects of training that may prove socially significant are the use of pyramidal training (training paraprofessional and paraprofessional training others). In pyramidal training, individuals are trained by trainers and then serve as trainers for another set of individuals (Whalen & Henker, 1971). By utilizing this type of training method, perhaps paraprofessionals may train other paraprofessionals to implement protocols without capitalizing on resources that educators cannot divide (e.g., time with PECS trainer).

Finally, two obvious extensions of the current study would be to investigate training to other phases of PECS and other AACs, and observe if savings is a robust effect of this type of training. If this is the case, then evidence may support incorporating this model of training in future empirical investigations of PECS in the natural environment, other AACs, and behavioral skills training protocols.

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BIOGRAPHICAL SKETCH

Glenn Matthew Sloman was born in 1980 and raised in Fort Lauderdale, FL. In 1998, Glenn moved to Gainesville, FL to attend the University of Florida. Glenn became interested in issues that affected people on a day-to-day basis while completing an anthropology course in Ecuador. He began volunteering at the OASIS Program, a program designed to assist freshmen minority students in becoming acclimated to college life. Additionally, he began to serve as an undergraduate research assistant in Dr. Lise Abrams aging and cognition laboratory. After completing his Bachelor of Science in psychology and Bachelor of Arts in anthropology in 2002, Glenn entered the masters program in counselor education in Spring 2003. While enrolled in the program, he was encouraged by Dr. Wayne Griffin to apply for the school psychology program. Glenn entered the school psychology doctoral program in Fall 2004 and specialized in behavior analysis, because of his interest in applying science to practical problems. In 2007, he completed his masters in school psychology. Glenn currently resides in Edison, NJ with his wife, Kim, and two dogs, and is a school psychology intern in the Somerset Hills School District. Upon graduation, Glenn plans to practice school psychology in New Jersey's public education school system.