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The Picture Exchange Communication System: Digital Photographs Versus Picture Symbols

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THE PICTURE EXCHANGE COMMUNICATION SYSTEM: DIGITAL PHOTOGRAPHS VERSUS PICTURE SYMBOLS

by

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The Picture Exchange Communication System (PECS) is an augmentative and alternative system (AAC) used to improve and increase communication for children with Autism Spectrum Disorder (ASD) and other developmental disorders. Research addressing the efficacy of this system is increasing; however, there is limited information published that evaluates the picture type used for PECS instruction. A single-subject alternating treatments design was used to examine the role of iconicity, or how closely a symbol resembles its referent, in the acquisition of picture discrimination in the third phase of PECS. The purpose of this study was to compare how well children were able to discriminate pictures with high iconicity versus pictures of low iconicity in Phase 3 of PECS. Four preschool children from 22–36 months of age with ASD or an Early Childhood Developmental Delay participated in the study. The results indicate that that there was minimal difference in picture discrimination between the two picture types. Children learn to discriminate equally well with pictures of low or high iconicity in the third phase of PECS instruction.

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INTRODUCTION

Statement of the Problem

The U.S. Department of Education reported a 59% increase in the number of 2-year-old children with disabilities receiving services under Part C of the Individuals with Disabilities Education Act (IDEA) from 1995 to 2004. Ten percent of children with developmental delays received services. The prevalence of developmental delays that resulted in eligibility for Part C services was much higher than previously thought (Rosenberg, Zhang, & Robinson, 2008). The number of children aged from 3 to 5 served under Part B of IDEA increased by 28% from 1995-2004. In 2004, 75,533 children from 3 to 5 years old receiving services had a developmental delay, and 5,709 had an Autism Spectrum Disorder (ASD). The number of all children identified with ASD increased 57% from 2002 to 2006 (Centers for Disease Control, 2009). The substantial increase in ASD and other early childhood developmental delays (ECDD) merited additional research on the best methods available to teach children with these developmental disorders (Goldstein, 2002; Koul, Schlosser, & Sancibrian, 2001; Lawler, 2008; Odom, Brown, Frey, Karasu, Smith-Canter, & Strain, 2003; Rutter, 2005; Schreibman, 2000; Schwartz, Sandall, Garfinkle, & Bauer, 1998; Singh, Illes, Lazzeroni, & Hallmayer, 2009; Wetherby, Prizant, & Hutchinson, 1998; White, Koenig, & Scahill, 2007). This research study compared two types of pictures used in the Picture Exchange Communication

System (Bondy & Frost, 1994), a form of augmentative communication taught to children with communication delays.

There have been meaningful advances made in treatment programs for young children with ASD and the outcomes from these programs have been impressive (Harris & Handleman, 1994; Lovaas, 1987; Odom et al., 2003; Schwartz, Sandell, et al., 1998). Treatment programs have focused on the deficits observed in children with ASD that interfere with learning and typical development. The areas of concern include impaired social interaction; problems with verbal and nonverbal communication; and unusual, repetitive, or severely limited activities and interests (American Psychiatric Association, 2004). This population generally presents deficits in communicating for social purposes, orienting or attending to social partners, or sharing affective or emotional states with others. Between 33-50% of children with ASD fail to develop functional speech. Other children affected experience delays in the development of speech and language (Wetherby, Prizant, & Schuler, 2000).

Children with other developmental delays also experience difficulties in language acquisition (Haile & Meaden, 2007). Only 19% of all children receiving early childhood special education services were reported to communicate their needs before receiving services (U.S. Department of Education, 2009). Children sometimes use inappropriate means of communication, such as tantrums, aggression, or self-injury when they have a limited ability to communicate (Frea, Arnold, & Vittimberga, 2001; Huaqing Qi & Kaiser, 2004; Olive & McEvoy, 2004; Wetherby et al., 2000). Acquisition of the most basic communication skills can have a tremendous impact on a child, allowing him or her to have more control of the environment (Goldstein, 2002), which could result in

decreased problem behaviors (Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Frea et al., 2001; Magiati & Howlin, 2003; Olive & McEvoy, 2004).

The importance of early intervention for children with disabilities was reflected in the creation of the Education of the Handicapped Act Amendments of 1986, which established the Early Intervention Program for Infants and Toddlers with Disabilities under Part H (now Part C) of IDEA. Early intervention provides greater opportunities for improved outcomes for children with disabilities (U.S. Department of Education, 2009). Young children with ASD often share many features with children with ECDD, which makes diagnosis difficult (Lord, 1995; Ventola et al., 2007). There has been minimal research conducted that specifically evaluates the differences between children with ASD and children with other early childhood delays (Ventola et al., 2007). Ventola and colleagues (2007) compared the cognitive, language, and adaptive skills between two groups of children in an attempt to investigate behavioral differences between the two groups. They investigated children with an ASD and those with a developmental language disorder or global developmental delay who failed the Modified Checklist for ASD in Toddlers (M-CHAT), an ASD screening tool for children between the ages of 16-30 months. The authors found that the children with an ASD were more impaired than those children with other delays, but the language skills were not significantly different when results from the Mullen Scales of Early Learning (Mullen, 1989) were examined. This may have been due to the fact that delays in language are often the initial reason for parent concern (Ventola et al., 2007). The similarity in language delays between children with ASD and ECDD may be addressed through similar communication interventions, such as augmentative and alternative communication (AAC).

One form of AAC that addresses the communication deficits of children with ASD and ECDD is the Picture Exchange Communication System (PECS). The PECS teaches children at a young age to communicate through the exchange of a picture of a preferred item with a communication partner (Bondy & Frost, 1994). The pictures used in the PECS vary across studies and include digital photographs and picture symbols. A search by this author of abstracting sources including PsycINFO, ERIC, and Google Scholar from 1994 through 2009 revealed no published study that compared the effectiveness of the specific type of pictures used in PECS in enabling very young children to discriminate between PECS pictures. A comparison of pictures used in PECS was the focus of this study.

Significance of the Study

There were 5,709 3-year-old children served under IDEA with an ASD, and 75,533 3-year-olds with an ECDD label who received services in 2004 according to the U.S. Department of Education (2009). There has been great emphasis placed on the use of interventions based on scientific evidence (Odom et al., 2003). In a review of single-subject design studies that illuminated effective educational practices for young children with autism, Odom et al. (2003) determined the use of one form of Augmentative and Alternative Communication (AAC), the PECS (Bondy & Frost, 1994), as an emerging and effective practice. The PECS has also been used effectively with children with other developmental delays (Schwartz, Garfinkle, & Bauer, 1998; Sulzer-Azeroff, Hoffman, Horton, Bondy, & Frost, 2009; Tincani, 2004).

The PECS was developed within the Delaware Autistic Program as a picture-based system for children with ASD to use as an initial mode of communication. Bondy and Frost (1994) found that over a 6-year period, 80% of the children entering the program did not have a functional means of communication. They cited an observation by Carr (1982) that "it appears that when children with ASD are taught to talk, the rate of speech acquisition is generally slow; and even when the effort proves successful, a tremendous amount of work is required of children and staff" (p. 1). Recently, 34 peer-reviewed published reports on PECS were analyzed by Sulzer-Azeroff et al. (2009). The findings demonstrated that PECS was being used successfully as a means of communication for those with limited or non-existent speech. Communication improved in a vast majority of research participants, who were able to communicate with teachers, parents, and members of the community. People used PECS to make requests and, in some cases, also used PECS to comment. "Results of several of the studies appear to indicate that intensive PECS training . . . can enable many participants to attain a functional communicative repertoire" (Sulzer-Azeroff et al., 2009, p. 98). However, a review of the research findings revealed no research evaluating the effectiveness of the type of pictures used when teaching discrimination between pictures in the PECS.

The Picture Exchange Communication System

The PECS is a functional, portable, and low-cost AAC system (Bondy & Frost, 1994). It is a picture-based training package that teaches children to exchange a picture of a desired item with a communication partner to receive the preferred item. The system is based on the principles of Applied Behavior Analysis (ABA), a well-researched strategy

for teaching children with ASD grounded in behavioral theory (Bondy & Frost, 2001; Ogletree & Oren, 2001). The PECS consists of six teaching phases and begins by teaching the exchange of a picture for the desired object. The first phase requires two trainers. Pictures of the selected items are available after determining preferences. The first trainer provides physical assistance to help the student pick up the representational picture and give it to the second trainer, who then provides the preferred item. The focus of the second phase is increasing spontaneity and increasing the distance the student travels to make the exchange. The design of the third phase is to teach the student to discriminate between pictures and remove pictures from a communication board. Next, the student learns to build simple sentences with the pictures on a sentence strip and exchange this strip for preferred items. It is not until the fifth phase that the child is actually asked to respond to the verbal prompt, "What do you want?"; all previous phases rely on the student's initiation. In the sixth phase, the student is asked to comment in response to a question (Bondy & Frost, 1994). When students use PECS, communicative partners do not require the specialized training that is necessary to understand sign language, and people that have had no prior experience with AAC systems (Stoner et al., 2006) can understand nonverbal communicators.

PECS as an Intervention

The use of AAC to improve communication skills for people with ASD and other developmental delays has been reported by many researchers (Bondy & Frost, 1994; Chambers & Rehfeldt, 2003; Charlop-Christy et al., 2002; Mirenda & Erickson, 2000). Sign language and picture systems have both been used successfully to augment or

replace spoken language (Goldstein, 2002). The PECS is a picture-based communication system that has been used effectively by a number of researchers to increase communication for children with language delays. Schwartz, Garfinkle, and Bauer (1998) found children with ASD, Down Syndrome, and ECDD learned PECS quickly and were able to use this method of communication across environments with various communication partners. Charlop-Christy et al. (2002), Ganz and Simpson (2004), and Yoder and Stone (2006) reported an increase in speech when children used PECS. Other researchers have reported an increase in communicative initiations in children with ASD following PECS instruction (Kravits, Kamps, Kemmerer, & Potucek, 2002).

Positive outcomes for communication and speech acquisition with PECS have been documented with children of various ages. Researchers have reported positive results with children from 3.8–12 years of age (Charlop-Christy et al., 2002), children from 3.9–7.2 years of age (Ganz & Simpson, 2004), and children from 3–6 years of age (Schwartz, Garfinkle, & Bauer, 1998). Bondy and Frost (1994) reported the acquisition of speech for a child that began using PECS at the age of 2.8 years old. The children in these studies were relatively young; however, progress has been made in diagnosing children as young as 18–24 months old (Wetherby, 2006).

The pictures used in the PECS include black and white drawings, color symbols, pictures from catalogs, product logos, scanned images, and digital images (Frost & Bondy, 2002). Further, using simple drawings is recommended due to ease of availability and the fact that the majority of children respond well to them. Yoder and Stone (2006) found children as young as 21 months of age learned to use the PECS, and Bondy and Frost (1994) successfully taught the PECS to a child who was 32 months old. However,

the specific type of visual representation (pictures, symbols, line drawings, etc.) used with the children in either study was not reported. It is necessary to sort out and study the unique characteristics of PECS, such as the visual nature of the pictures used as suggested by Ganz and Simpson (2004).

The pictures used to teach children the PECS may have an impact on the child's ability to discriminate between pictures. The iconicity of a graphic symbol has been observed to influence the acquisition of that symbol. "Iconicity is defined as the degree to which a graphic symbol, or gesture (or some aspect of the symbol, sign, or gesture) resembles or suggests its referent" (Koul et al., 2001, p. 163). Mirenda and Locke (1989) compared symbol transparency using a match to sample task with individuals with disabilities. They found the easiest task to be matching objects, followed by color photographs, black and white photographs, miniature objects, symbols, and the most difficult symbol being the written word. In another study, Ganeau, Pickard, and DeLoache (2008) reported that 15- and 18-month-old children were better able to transfer information between a symbol and referent using early picture books when there were higher levels of similarity between the symbol and referent. The concept of iconicity was discussed by Koul et al. (2001), with degrees represented on a continuum. The continuum ranged between transparent symbols that could be identified without cues to opaque symbols that did not resemble their referent. Translucent symbols fell within the middle of the continuum. Koul et al. (2001) suggested that educators follow a hierarchy of symbol teaching. Color photographs with a greater level of iconicity may be easier for children to discriminate than picture symbols based on this theory of symbol transparency.

The current investigation aimed to compare the effectiveness of digital photographs (more transparent symbols) and picture symbols (less transparent symbols) in teaching the PECS to preschool children with ASD. The effectiveness of these pictures was determined by collecting data on the accuracy in picture discrimination for each type of visual representation.

Rationale for the Study

There is a need for additional research to support the effectiveness of the PECS for children under 3 years old, as there are few published studies that include participants of this age (Sulzer-Azaroff et al., 2009). It is important to determine whether the use of photographs or symbols may be the most appropriate in the PECS training for very young children who are just beginning to learn a communication system. Using one type of picture rather than another could improve the accuracy of discrimination between pictures for children during the PECS communication. As children are identified with ASD and other developmental disorders at younger ages, it is imperative to ascertain any modifications to current interventions that would result in successful communication for the youngest children involved in intervention. Communication intervention has proven to be most effective when provided before the age of 42 months (Harris & Handleman, 1994). The purpose of the current study was to determine the relative efficacy of photographs and symbols in the PECS for children diagnosed with ASD and other developmental delays from 18–36 months of age. The study was designed to establish the type of picture that will enable children with absent or limited spoken language to

communicate efficiently and effectively. Specifically, the researcher evaluated the accurate discrimination between pictures for very young children.

Overview of Study

The current study was a single-subject, alternating treatments design (Barlow & Hayes, 1979). The purpose of this study was to determine whether the type of picture used in teaching the PECS to preschool children with ASD and other developmental delays has an impact on correct picture discrimination. Data were collected on correct and incorrect picture discriminations made by the children during the third phase of PECS. The data were graphed using an Excel spreadsheet and analyzed by visual inspection.

Research Questions

The purpose of this investigation was to determine whether the type of picture used in teaching PECS to preschool children with ASD and other developmental disabilities has an impact on correct picture discrimination. This study addressed the following two research questions:

$R_{1:}$ Does the use of digital photographs in PECS training result in a larger percentage of correct picture discriminations?

$R_{2:}$ Does the use of picture symbols in PECS training result in a larger percentage of correct picture discriminations?

The corresponding null hypotheses are:

$H_{01:}$ The use of digital photographs in PECS training does not result in a larger percentage of correct picture discriminations.

$H_{02:}$ The use of picture symbols in PECS training does not result in a larger percentage of correct picture discriminations.

Assumptions

In order to answer the above research questions and corresponding null hypotheses, this study assumes:

1. The investigator measured the children's ability to discriminate between pictures in quantifiable terms.

2. The children demonstrated their ability to discriminate between pictures.

Summary

Children diagnosed with ASD pose a challenge for educators, especially in the primary deficit area of communication (Angermeier, Schlosser, Luiselli, Harrington, & Carter, 2007; Carr & Felce, 2007; Charlop-Christy et al., 2002). Several forms of AAC have been used to improve communication, including a picture-based system, the PECS. The research conducted utilizing PECS has been encouraging but limited, as experimental control was absent in most of the studies (Carr & Felce, 2007). Few studies included children less than 3 years of age, and no published studies were found that directly evaluated the efficacy of different types of pictures used to teach the PECS in the discrimination phase. This investigation compared two picture types to determine which would result in more effective picture discrimination. Chapter II will discuss the past and current PECS research within the field of special education.

Definition of Terms

Applied Behavior Analysis: Applied behavior analysis (ABA) is the science of applying experimentally derived principles of behavior to improve socially significant behavior. ABA takes what we know about behavior and uses it to bring about positive change (Applied). Behaviors are defined in observable and measurable terms in order to assess change over time (Behavior). The behavior is analyzed within the environment to determine what factors are influencing the behavior (Analysis) (Poling, personal communication, 2009). Baer, Wolf, and Risley (1968) described the seven dimensions of Applied Behavior Analysis. Poling, Methot, and LeSage (1995) provide a brief description of the seven dimensions as:

> *Analytic:* An analytic study employs a convincing experimental design, that is, one that allows the researcher to state with confidence whether or not the independent variable influenced the dependent variable.
>
> *Applied:* A study is applied if it attempts to improve behaviors that constitute a problem for the behaving individual or for another person with a legitimate interest in the behaving individual.
>
> *Behavioral:* A study is behavioral if it measures what a subject actually does and focuses on that activity as important in its own right, not as a sign or symptom of activity at another level of analysis.
>
> *Conceptual:* A study is conceptual to the extent that its procedures make sense in terms of, and are described with reference to, accepted principles of behavior.
>
> *Effective:* An effective study is one in which the changes in behavior actually benefit participants. In other words, an effective study produces clinically significant behavior change.
>
> *Technological:* A technological study is described with sufficient clarity and detail to allow others to replicate it.
>
> *Generality:* A study has generality to the extent that its results are demonstrated across time, or across various kinds of participants, problem behaviors or settings.
>
> (Poling et al., 1995, pp. 7-8)

Augmentative and Alternative Communication (AAC): Augmentative and alternative communication is:

> (1) The supplementation or replacement of natural speech and/or writing using aided and/or unaided symbols. . . . The use of aided symbols requires a transmission device.
>
> (2) The field or area of clinical/educational practice to improve the communication skills of individuals with little or no functional speech.
>
> (Lloyd, Fuller, & Arvidson, 1997, p. 254)

The American Speech-Language-Hearing Association provides further clarification:

> Augmentative and alternative communication (AAC) includes all forms of communication (other than oral speech) that are used to express thoughts, needs, wants, and ideas. We all use AAC when we make facial expressions or gestures, use symbols or pictures, or write.
>
> People with severe speech or language problems rely on AAC to supplement existing speech or replace speech that is not functional. Special augmentative aids, such as picture and symbol communication boards and electronic devices, are available to help people express themselves. This may increase social interaction, school performance, and feelings of self-worth.
>
> AAC users should not stop using speech if they are able to do so. The AAC aids and devices are used to enhance their communication (American Speech-Language-Hearing Association, 2010, p. 1).

Autism Spectrum Disorder (ASD):

> (1) Autism spectrum disorder is considered a lifelong developmental disability that adversely affects a student's educational performance in 1 or more of the following performance areas:
>
> (a) Academic
>
> (b) Behavioral
>
> (c) Social
>
> Autism spectrum disorder is typically manifested before 36 months of age. A child who first manifests the characteristics after age 3 may also meet criteria. Autism spectrum disorder is characterized by qualitative impairments in reciprocal social interactions, qualitative impairments in communication, and restricted range of interests/repetitive behavior.

(2) Determination for eligibility shall include all of the following:

(a) Qualitative impairments in reciprocal social interactions including at least 2 of the following areas:

(i) Marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction.

(ii) Failure to develop peer relationships appropriate to developmental level.

(iii) Marked impairment in spontaneous seeking to share enjoyment, interests, or achievements with other people, for example, by a lack of showing, bringing, or pointing out objects of interest.

(iv) Marked impairment in the areas of social or emotional reciprocity.

(b) Qualitative impairments in communication including at least 1 of the following:

(i) Delay in, or total lack of, the development of spoken language not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime.

(ii) Marked impairment in pragmatics or in the ability to initiate, sustain, or engage in reciprocal conversation with others.

(iii) Stereotyped and repetitive use of language or idiosyncratic language.

(iv) Lack of varied, spontaneous make believe play or social imitative play appropriate to developmental level.

(c) Restricted, repetitive, and stereotyped behaviors including at least 1 of the following:

(i) Encompassing preoccupation with 1 or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus.

(ii) Apparently inflexible adherence to specific, nonfunctional routines or rituals.

(iii) Stereotyped and repetitive motor mannerisms, for example, hand or finger flapping or twisting, or complex whole body movements.

(iv) Persistent preoccupation with parts of objects.

(3) Determination may include unusual or inconsistent response to sensory stimuli, in combination with subdivisions (a), (b), and (c) of subrule 2 of this rule.

(4) While autism spectrum disorder may exist concurrently with other diagnoses or areas of disability, to be eligible under this rule, there shall not be a primary diagnosis of schizophrenia or emotional impairment.

(5) A determination of impairment shall be based upon a comprehensive evaluation by a multidisciplinary evaluation team including, at a minimum, a

> psychologist or psychiatrist, an authorized provider of speech and language under R 340.1745(d), and a school social worker.
>
> (Michigan Department of Education, 2009, pp. 21-22)

Early Childhood Developmental Delay (ECDD):

> (1) "Early childhood developmental delay" means a child through 7 years of age whose primary delay cannot be differentiated through existing criteria within R 340.1705 to R 340.1710 (cognitive impairment, emotional impairment, hearing impairment, visual impairment, physical impairment otherwise health impairment) or R 340.1713 to R 340.1716 (speech and language impairment, specific learning disability, severe multiple impairment, ASD spectrum disorder) and who manifests a delay in 1 or more areas of development equal to or greater than 1/2 of the expected development. This definition does not preclude identification of a child through existing criteria within R 340.1705 to R 340.1710 or R 340.1713 to R 340.1716.
>
> (2) A determination of early childhood developmental delay shall be based upon a comprehensive evaluation by a multidisciplinary evaluation team.
>
> (Michigan Department of Education, 2009, p. 16)

Picture Exchange Communication System (PECS): PECS was developed by Andrew S. Bondy, Ph.D., and Lori Frost, M.S., CCC/SLP, in 1985 as a unique augmentative and alternative communication intervention package for individuals with autism spectrum disorder and related developmental disabilities. First used at the Delaware Autistic Program, PECS has received worldwide recognition for focusing on the initiation component of communication. PECS does not require complex or expensive materials. It was created with families, educators, and resident care providers in mind, so is readily used in a range of settings.

PECS begins by teaching an individual to give a picture of a desired item to a "communicative partner," who immediately honors the exchange as a request. The system progresses to teach discrimination of pictures and how to put them together in sentences. Individuals are taught to answer questions and to comment in the more advanced phases.

The PECS teaching protocol is based on B.F. Skinner's book, *Verbal Behavior*, such that functional verbal operants are systematically taught using prompting and reinforcement strategies that will lead to independent communication. Verbal prompts are not used, thus building immediate initiation and avoiding prompt dependency.

PECS has been successful with individuals of all ages demonstrating a variety of communicative, cognitive, and physical difficulties. Some learners using PECS also develop speech. Others may transition to a voice output system. The body of research supporting the effectiveness of PECS continues to expand, with research from countries around the world (Bondy & Frost, 2010, p. 1).

CHAPTER II

REVIEW OF THE LITERATURE

The following is a review of past and current literature within the area of communication acquisition for people with autism spectrum disorder (ASD) and other developmental delays. The purpose of this review was to examine and assess research within this area as well as emphasize the significance of the investigations. Chapter II addresses the literature regarding various AAC systems, including manual sign language and picture-based systems used with children with ASD and other developmental disabilities, and reviews results of studies conducted on the use of the Picture Exchange Communication System (PECS). The studies discussed include the results of the initial research on the PECS by Bondy and Frost (1994). Studies conducted comparing the PECS to sign language (Chambers & Rehfeldt, 2003; Tincani, 2004) reported an increase in communicative initiation (Carr & Felce, 2007; Howlin, Gordon, Pasco, Wade, & Charman, 2007; Kravits et al., 2002), and research on the increase in speech following the PECS training (Charlop-Christy et al., 2002; Ganz & Simpson, 2004; Yoder & Stone, 2006) is examined. Additionally, research concerning iconicity and the effects this symbol variable has on symbol acquisition is discussed. The need for future research is also reviewed.

Wetherby, Prizant, and Schuler (2000) reported that 33–50% of children with ASD experience delays in speech or fail to develop functional speech altogether. Speech

and language intervention strategies for children with autism and other developmental disabilities include speech therapy and various augmentative and alternative communication (AAC) systems. Spoken language can be very difficult to establish in children with developmental disabilities when speech does not develop typically (Sundburg, 1993). The limited success of speech therapy for some children with ASD and ECDD has resulted in the development of numerous AAC systems, including sign language, picture pointing systems (Sundberg, 1993), and picture exchange systems (Bondy & Frost, 1994).

A number of studies reported on the use of one form of AAC, the Picture Exchange Communication System (PECS) developed by Frost and Bondy (Sulzer-Azeroff et al., 2009). The PECS teaches children to give a picture of an item they want as a request to receive the preferred item. The system iss based on the principles of Applied Behavior Analysis (ABA), a well-researched strategy for teaching children with ASD grounded in behavioral theory (Bondy & Frost, 2001; Ogletree & Oren, 2001). Mirenda and Erickson (2000) expressed concern that, despite the limited published empirical studies on the use of PECS for children with ASD, the system is being used in many schools. The research base has continued to grow since 2000 and at least 30 additional studies have been published on the use of PECS (Sulzer-Azeroff et al., 2009). The studies include retrospective reports (Bondy & Frost, 1994; Schwartz et al., 1998; Webb, 2000), alternating treatments studies (Chambers & Rehfeldt, 2003; Tincani, 2004), multiple baseline studies (Charlop-Christy et al., 2002; Kravits et al., 2002), and pilot evaluation studies (Carr & Felce, 2007; Magialti & Howlin, 2003), among others. Eighteen of the studies included children from 1.5 to 6 years of age (Sulzer-Azeroff et al., 2009).

Communication Interventions

Manual Sign Language

Attempts to teach language to children with Autism Spectrum Disorder have included speech therapy, sign language, and visual communication systems (Charlop-Christy et al., 2002; Frea et al., 2001). An analysis of peer-reviewed research articles published over the past 20 years (Goldstein, 2002) revealed that manual sign language or total communication training resulted in quicker acquisition of language and a more complete vocabulary than speech therapy. This may be due to the fact that the visual modality is an area of strength for people with ASD. Children with ASD, regardless of level of functioning, perform better on visuospatial skills than they do on social or reasoning tasks (Quill, 1997). Although manual sign language training is more effective than speech training, the results of this system are mixed. Prerequisite skills such as visual orientation and fine motor imitation are required for the acquisition of signs (Sundburg, 1993). Children may have difficulty using signs spontaneously or in different environments (Carr, 1982). Some children may also have difficulty making signs accurately and furthermore the communicative partners are limited to those who know sign language (Rothholtz, Berkowitz, & Burberry, 1989, Mirenda & Erickson, 2000). A communication system that is clear and easy to use was determined to be important for successful communication (Potter & Whittaker, 2001). Several researchers posited that two-dimensional pictures that resemble their referents may be easier for some children with autism to learn than manual signs, which may not resemble the referents they represent (Mirenda & Erickson, 2000; Rothholtz et al., 1989; Tincani, 2004).

Picture-Based Systems

Many alternative communication systems include the use of pictures in an effort to capitalize on the visual strengths of children with autism (Mirenda & Erickson, 2000). These communication systems are used more frequently and successfully than unaided systems due to the match between the characteristics of ASD and the use of picture-based communication systems. Some systems require the child to point to specific pictures. Picture pointing systems typically begin by teaching the child to match objects, match objects to pictures, and then match pictures to objects. The child then learns to point to the pictures (Bondy & Frost, 1994). A weakness of a picture pointing system is that it is difficult to ensure that someone actually sees an individual's request, and this response can be extinguished if the individual points to a desired item and does not receive it (Reichle, York, & Sigafoos, 1991).

Teaching Labels or Requests

Many programs designed to teach language begin by teaching labeling (Carr, 1982). The labeling programs typically rely on artificial motivators, usually unrelated, tangible reinforcers. Bondy and Ryan (1991) cautioned that the use of artificial motivators does not address the function of communication and that teaching requesting should be the first skill taught. Effective reinforcers maintain teaching requesting, and learning is fast since a child can immediately get what he or she wants. Reinforcement has to be immediate in order for children with ASD to make a connection between their actions and the consequences of those actions (Beisler & Tsai, 1983). Bondy and Frost (1994) posited

that the exchange of a picture for a reinforcing item closely parallels a typical communicative exchange. Fay and Schuler (1980, cited in Beisler & Tsai, 1983) have also suggested that teaching requests follow what we already know about typical child development.

The Picture Exchange Communication System

Bondy and Frost (1994) developed the Picture Exchange Communication System (PECS) to address concerns with the existing communication training systems. The communication training system was first developed at the Delaware Autistic Program in 1987. The PECS teaches children with ASD to communicate through the exchange of a picture for a preferred item with a communication partner (Bondy & Frost, 1994). This allows children to access reinforcers in a social context through communication they initiate (Frost & Bondy, 2002). Initiation by the communicator is a fundamental component of PECS and is reinforced throughout the PECS training. Additionally, the use of PECS does not require eye contact or imitation skills that are prerequisites in other Augmentative and Alternative (AAC) systems (Stoner et al., 2006).

The Picture Exchange Communication System Studies

The Initial PECS Study

The first study published on the PECS was a retrospective report that documented positive outcomes in children's ability to communicate with this picture-based form of AAC (Bondy & Frost, 1994). The authors described how 80% of the young children age 5

and younger with ASD that entered the Delaware Autistic Program (DAP) did not have functional speech. Their research was conducted over a 6-year period. The PECS is an iconic communication system developed by Bondy and Frost (1994) to teach young children a means of communication. The researchers followed the progress of 85 children who learned to communicate using the PECS at the DAP. The children were of various cognitive abilities ranging from average cognition levels to severe developmental disabilities. Bondy and Frost reported that for 66 children who used PECS for more than a year, 39 (59%) acquired speech with no formal speech training and used speech as their only form of communication. Of the 85 children included in the review, 76% used either speech or speech augmented with PECS to communicate. The majority of the children that did not develop speech displayed severe developmental disabilities.

PECS Versus Sign Language

Two studies compared the effects of the PECS and sign language. Chambers and Rehfeldt (2003) compared the PECS with sign language to teach three adults with severe developmental disabilities. The researchers taught the same four mands (requests) using PECS and sign language using an alternating treatment design. One half of each 30- to 40-minute instructional session focused on teaching mands using PECS, and the other half of the session focused on teaching sign language. The PECS resulted in faster acquisition of manding, and all three participants were able to generalize across settings. Tincani (2004) also used an alternating treatment design to evaluate the effectiveness of PECS versus sign language with two school-aged children with ASD. The children were 5.10 and 6.8 years old, and were enrolled in a self-contained classroom for children with

multiple disabilities. The children received sign language and picture exchange training in alternating treatments across days of the week, time of day, order of presentation, and trainers. The results revealed that the level of independent requesting by one child was three times greater with PECS than with sign, and that sign language training initially produced more word vocalizations than PECS training. Following a procedural modification to the PECS system (a reinforcement delay procedure), the child's vocalizations increased to a level similar to sign language training. For the other child, sign language training resulted in a greater number of requests than PECS training, and sign language training resulted in more than twice the vocalizations than PECS training. One child used PECS more effectively; the other used manual sign more effectively to communicate.

Initiation with PECS

Young children with ASD demonstrate a substantial failure to initiate communication (Irwin, 2007; Mundy, 2005) or communicate spontaneously in addition to having limited communication skills. Early initiations were found to be predicative of later language ability (Drew, Baird, Taylor, Milne, & Charman, 2007). It was recommended that promoting spontaneous communication and reducing prompt dependence be a priority in teaching communication skills to children (Charlop & Haymes, 1998). In a group randomized controlled trial by Howlin et al. (2007), the median rates of initiation with a group of children between 4 and 11 years old diagnosed with ASD increased after PECS training. The group of 56 elementary children attended classes or programs for children with ASD. The focus of the study was to assess the

effectiveness of expert training and consultation for teachers in the use of PECS. Some children had been exposed to PECS or PECS-like interventions before the study, as the use of the system is widespread in the United Kingdom where the study was conducted. The average picture use by the children increased from 12 to 40 an hour following formal PECS training. The children showed a median rate of initiations at 15 per hour before training, which increased to 26 per hour following intervention.

Kravits et al. (2002) successfully taught a 6-year-old girl with ASD to use the PECS while tracking her progress using a multiple baseline design study across multiple settings. The girl attended a general education kindergarten program in a public school with 30 to 60 minutes of special education daily, and the settings for the study included both home and school. Her rate of initiations increased from 8 to 9 initiations at baseline, to 18 initiations using both PECS and spontaneous verbalizations during play. The child's initiations during work centers increased from 3 to 5 initiations at baseline to 11, and during journal writing initiations went from a mean of 4 to 7 during baseline to 14 during intervention. She reliably used icons in all settings.

Carr and Felce (2007) taught PECS to a control group of 24 children with ASD between 3 and 7 years old. The children attended special education classrooms or programs for children with ASD. The study used both a within-subjects and between groups measure to determine the effects of the PECS training. The children in the PECS group developed spontaneous communicative initiations within the first 15 hours of focused PECS instruction. Overall, the mean of child initiations in the PECS group increased from 9.9 per 20-minute session at baseline to 61.4 during the second observation, compared to a decrease of 12.6 to 10.0 from the first to second observation

for the control group. The communicative initiations generalized across objects, activities, settings, and people.

Increase in Speech

The successful acquisition of the PECS and an increase in speech was reported in four additional studies. Charlop-Christy et al. (2002) successfully taught the PECS to three boys with ASD using a multiple baseline design. The participants were 3.8, 5.9, and 12 years of age. The study was conducted in an after-school behavioral treatment program. During this study the mean length of utterance (MLU) was recorded for each occurrence of spontaneous speech. All three participants demonstrated an increase in spontaneous communication and an increase in MLU. For one child, the rate of initiation increased from 28% of trials to baseline to 100% of trials following training. Initiations went from 2% at baseline to 68% following intervention for the second subject. The third subject did not display any initiation during baseline, but following PECS training he displayed spontaneous speech on 83% of trials. Additionally, the MLU increased for each of the subjects, and each participant experienced a decrease in at least one problem behavior following PECS training.

Ganz and Simpson (2004) conducted a single-subject within-subject changing criteria study with three children, one preschool-aged child and two elementary-aged children, all diagnosed with ASD. The elementary-aged children attended a general education classroom and the youngest child attended an early childhood special education classroom. The participants had no spoken words or only one-word utterances when the PECS training began. Observers collected data on each participant's ability to use the

PECS as well as the number of words used. The students learned to use the PECS, and all three displayed increases in vocal verbal behavior as well. All three students were using 3–4 word phrases at the conclusion of training. The average number of spoken words increased from 0.36 during the first phase of PECS training to 2.7 words per trial in phase 4. The second participant displayed an increase in spoken words from a mean of 0.4 to 3.68 words in the fourth phase. The data from the third child indicated an increase in spoken words from 0.64 to 2.89 words per trial.

Yoder and Stone (2006) demonstrated an increase in both the frequency and number of non-imitative words following PECS instruction in a randomized group experiment with 36 preschoolers with ASD. The children ranged in age from 21–54 months of age and participated in the research at a university clinic. The children demonstrated an average of 0.17 spoken words during a 15-minute semistructured play period with the researchers. Following PECS instruction, the mean spoken words increased to 3.1 spoken words at the final observation. This increase was measured in a context that required generalization to a new person, new toys, new activities, and new interaction styles.

Related research by Schwartz, Sandell, et al. (1998) taught the PECS to 18 children from 3–6 years of age diagnosed with ASD or other developmental disabilities who participated in an integrated preschool program. Children learned PECS quickly and were able to use this method of communication across environments with various communication partners. The number of spoken words also increased for all participants. Data were collected during a 15-minute snack group and a 30-minute play group. Each child was observed three times over a 12-month period. Following the initial observation,

children who demonstrated 5 or more words were defined as talkers, and non-talkers displayed 5 or fewer words. For the talkers, the average number of spoken words during the first play time observations was 12, which increased to 40 at the third observation. For the non-talkers, average spoken words increased from 1 to 4 over the three observations. During snack time, the talkers initially used an average of 8 words, and at the third snack time it was observed that the average number of words spoken was 34. An average of 1 spoken word was observed during the first snack time for the non-talkers, and an average of 3 at the final observation. Spoken language developed in 44% of the children, and all of the children initially categorized as talkers stopped using PECS and relied on speech alone to communicate.

Iconicity

The degree that a symbol suggests or resembles its referent is referred to as iconicity (Koul et al., 2001), and is also referred to as the transparency of the symbol. The degree of visual representation, or transparency, of the pictures used to teach the PECS may have an impact in young children's ability to discriminate between pictures when using the PECS. Several studies have demonstrated that a greater degree of iconicity results in an increased ability to learn symbols in children and young adults with disabilities. Mirenda and Locke (1989) compared symbol transparency using a match to sample task with individuals with disabilities. They found the easiest task to be matching objects, followed by color photographs, black and white photographs, miniature objects, symbols, and the most difficult symbol being the written word. Kozleski (1991) used a modified multiple baseline with four students diagnosed with ASD ranging in ages from

7 to 13 years. The study investigated the students' ability to learn five visual symbol sets ranging from more to less transparent in nature: (1) photopictorial, (2) rebus, (3) Blissymbolics, (4) orthography, and (5) Premack-type tokens. All four students reached criterion with fewer trials in systems that had a higher degree of iconicity.

Iconicity was also evaluated in very young children interacting with picture books. Ganeau et al. (2008) evaluated 15- and 18-month-old children's ability to transfer a label that they learned for a real object to a picture of the object in two studies. In the first study, Ganeau et al. demonstrated that 15- and 18-month-old children were able to extend the label learned for a picture to an actual object. The pictures were photographs, detailed color drawings, or cartoons that had less detail and distorted the overall shapes of the objects to some degree. When extending the novel label from the depicted to the real object, the level of iconicity had no effect on the 18-month-old children; however, the 15-month-old children were not able to extend the label in the cartoon condition. The older children were successful with the more realistic pictures, but were not successful with the cartoons when asked to generalize the new name to a novel example of the object. In a second study, the participants included 69 children, aged 15 or 18 months of age, that did not participate in the first study. The children participated in two book conditions, photographs and cartoons, and were randomly assigned to one of the book groups. The research illuminated the role of iconicity in the extension and generalization of information. The 15-month-olds did not extend the label learned from a cartoon to a new object, and children in both age groups were unable to extend a label learned from a real object to a cartoon. Neither group was able to generalize from cartoons to objects or objects to cartoons.

Angermeir et al. (2007) evaluated the effects of picture iconicity on requesting in the PECS. Four children between 6 and 10 years old that were either diagnosed with ASD or pervasive developmental disabilities participated in the study. The study took place in an assessment area within the children's school. An alternating treatments design was used to compare Picture Communication Symbols (PCS) identified as having high iconicity to Blisssymbols, which have a low iconicity as rated by 48 high school and junior high students. The two sets of symbols used to teach the PECS were black and white. The results of the study showed very little difference in the students' ability to use PECS for requesting in Phase 1 and Phase 2 of training. Three of the students did not reach mastery of Phase 3 (discrimination) of the PECS before the study was terminated; however, one student consistently showed a greater percentage of correct discrimination in the more transparent PCS condition.

Need for Additional Research

The role of iconicity on students' ability to discriminate between symbols in Phase 3 of the PECS has not been established. Miranda and Locke (1989) and Kozleski (1991) demonstrated that a higher degree of symbol iconicity increases task success for students with disabilities. Ganeau et al. (2008) reported that for very young children the transparency of symbols had an impact on children's ability to transfer the label of an object to a corresponding picture. As suggested by Ganz and Simpson (2004), it is necessary to sort out and study the unique characteristics of PECS such as the visual nature of the pictures used. The degree of iconicity in the symbols used in the PECS can

play a crucial role in the ability of young children with ASD and other disabilities to discriminate between symbols as they learn the PECS to augment their communication.

Summary

Chapter II addressed the literature concerning various communication systems used with students with disabilities. The interventions included manual sign language and picture-based systems such as the PECS. The chapter discussed results of research conducted on the use of the PECS. The first study discussed was the results of the initial research on the PECS by Bondy and Frost (1994). Results of research conducted comparing the PECS to sign language, increases in communicative initiation, and research on the increase in speech following the PECS training were examined. Additionally, Chapter II explored the role iconicity may have on successful discrimination of pictures in the PECS.

Chapter III establishes a foundation and rationale for the use of a single-subject alternating treatments design to compare the efficacy of two types of visual representations often used in teaching the PECS protocol to individuals with limited communication skills. The methodology is explained in detail, and the limitations of this study are addressed.

CHAPTER III

METHODOLOGY

This investigation explored whether the type of picture used in teaching the Picture Exchange Communication System (PECS) to preschool children with Autism Spectrum Disorder (ASD) or Early Childhood Developmental Delay (ECDD) has an impact on correct picture discrimination. The PECS is an alternative and augmentative communication system used to teach communication skills to children with limited or nonexistent language skills (Bondy & Frost, 1994). This study addressed the following two research questions:

$R_{1:}$ Does the use of digital photographs in PECS training result in a larger percentage of correct picture discriminations?

$R_{2:}$ Does the use of picture symbols in PECS training result in a larger percentage of correct picture discriminations?

This investigation used a single-subject alternating treatments design (Barlow & Hayes, 1979) to determine whether the use of digital photographs or picture symbols is more effective in teaching children with disabilities to discriminate between pictures. The investigation's design is examined in the research foundation section. The investigator describes the rationale for the research as well as the advantages and disadvantages of this design. Participant descriptions are included in the methodology section. Participants included four preschool children with ASD and other developmental delays, the

investigator who was a certified special education teacher and doctoral candidate, and psychology practicum students who participated as tutors in the classroom. This investigation was conducted in a center-based public school building. The investigator describes the materials used and the study's design. The procedure is described, which included three phases: (1) basic picture exchange, (2) distance and persistence, and (3) picture discrimination. The data collected on the third phase of the PECS procedure were used to answer the research questions. The methods section then describes the preference assessment, collection of baseline data, and the PECS training. Next, the methods section describes the collection of interobserver reliability, the analysis of data, and the limitations of the study.

Research Foundation for Alternating Treatments Design Method

The alternating treatments design (Barlow & Hayes, 1979) involved repeated measurement of behavior while conditions rapidly alternated between two separate interventions, or between baseline and a single intervention (Poling et al., 1995). Cooper, Heron, and Heward (2007) described "other terms used in the applied behavior analysis literature to refer to this analytic tactic include multielement design (Ulman & Sulzer-Azeroff, 1975), multiple schedule design (Hersen & Barlow, 1976) concurrent schedule design (Hersen and Barlow, 1976), and simultaneous treatment design (Kazdin & Hartman, 1978)" (p. 188).

The alternating treatments design has been used in research on the Picture Exchange Communication System (PECS). Chambers and Rehfeldt (2003) used an alternating design treatment to determine whether manual sign or PECS would be more

effective in teaching requesting skills to adults with cognitive impairments. Each participant was taught four requests using PECS and sign language. Half of each training session was used to teach requesting using one method of communication, and the other method was taught in the second half of the training session. Evaluating the percentage of correct responses for each communication method allowed the researchers to compare the two methods. The degree of experimental control was determined by inspecting the data paths that represented the two treatments.

Tincani (2004) also used an alternating treatment design to compare PECS to sign language in the acquisition of requesting skills. The study included two elementary aged students with ASD. The students' ability to request using their preferred modality learned with the experimenter generalized to the classroom teacher.

In an alternating treatments design, the treatments can be alternated each day, in different sessions on the same day, or implemented each during a portion of the same session (Cooper et al., 2007). This investigation implemented the third option, by presenting preferred objects represented by digital photographs or picture symbols within each session. Counterbalancing the sequence the pictures are presented during each session, and the persons conducting each session, helps to ensure the outcome is based on the treatments themselves rather than some other variable (Cooper et al., 2007). A two-phase design was used that began with an initial baseline phase followed by a phase that alternated the two picture types.

Rationale for Alternating Treatments Design Method

Advantages of the Alternating Treatments Design

The alternating treatments design has a number of advantages. One important advantage is that the investigator was able to demonstrate a functional relation without withdrawing an effective treatment. Reversing improvements may result in serious ethical concerns. Additionally, many behaviors do not return to baseline levels when the treatment is withdrawn (Cooper et al., 2007). The alternating treatments design is effective for highly variable behavior, which often fluctuates in applied settings. Conditions change regardless of the subject's behavior with this design (Poling et al., 1995). In a multiple baseline design, withholding treatment for a period of time has ethical implications that are overcome with the alternating treatments design, which allows for early initiation of treatment. This design also allows for a quick evaluation of treatment (Cooper et al., 2007; Poling et al., 1995). An alternating treatments design could reduce the possibility that the results are due to sequence effects when conducted properly (Cooper et al., 2007). When the treatment conditions are alternated rapidly, it can be presumed that variables such as maturation or the effects of practice are equally represented in each treatment condition. The alternating treatments design also allows for testing of generalization across stimuli or trainers (Cooper et al., 2007).

Disadvantages of the Alternating Treatments Design

A disadvantage of the alternating treatment design is that due to the rapid alternation of conditions, brief exposure to either treatment may not provide evidence of

the treatments' effect (Poling et al., 1995). There is also a possibility of multiple treatment interference, which refers to whether the effects of either of the alternated treatments would be the same if the treatments were presented alone (Cooper et al., 2007). Additionally, the rapid switching of treatments is artificial; alternating treatments design has a limited capacity in that only 2 to 4 treatments can be compared. Care has to be used in selecting treatments, and treatments must be selected that are representative of current practice or those that can be easily implemented (Cooper et al., 2007).

Methodology

Participants

The participants were four children between 18-36 months of age that participated in an intensive early behavioral intervention program in a public school. The children were diagnosed with Autism Spectrum Disorder or Early Childhood Developmental Delay by the multidisciplinary evaluation team of the school district. This team included a speech tutor, a school psychologist, a social worker, and an occupational tutor. The educational label for each student was based on the results from administration of the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) and other assessments. Information on the children's cognitive skills was obtained through The Birth to Three Comprehensive Test of Developmental Abilities-2 (BTAIS-2; Ammer & Bangs, 2000). The Preschool Language Scales–4 (PLS-4; Zimmerman, Steiner, & Pond, 2002), and/or the Toddler Speech/Language Checklist from the Infant/Toddler Developmental Assessment (IDA; Provence, Erikson, Vater, & Palermi, 1995), which

were used as guidelines to assess the children's speech and language skills. Social skills were evaluated with the Developmental Assessment of Young Children (DAYC; Voress & Maddox, 1998) and the Birth to Three Comprehensive Test of Developmental Abilities from the (BTAIS-2; Ammer & Bangs, 2000). The children's sensory processing skills were measured with the Infant/Toddler Sensory Profile (Dunn, 2002). Parent reporting and historical developmental reporting were also used to determine that the children met the state special education eligibility requirement for Autism Spectrum Disorder or Early Childhood Developmental Delay.

The children had no previous experience with the Picture Exchange Communication System (PECS). All children had significant communication delays. The children were nonverbal or had fewer than 18 words, gestures, or signs as demonstrated through the assessment procedure.

Settings

The PECS training took place in the children's natural school setting as suggested to promote skill generalization (Koegel, 2000). The PECS trials occurred in the public school building the children attended, and instruction took place in individual learning booths, various other places within the classroom, and throughout the school building. Initial training trials occurred in the learning booths, which consisted of two chairs facing each other and a desk or small table. As the training progressed, trials were conducted in various locations within the classroom to promote generalization and allow for increased distances between the child and tutor. The training also occurred during a playtime and a snack group. The PECS training was provided along with other learning objectives, such

as attending, imitation, and following directions as specified in each child's Individualized Education Plan.

Tutors

University students who regularly participated as tutors in the intensive behavioral intervention classroom conducted training on the first two phases of PECS. Applied Behavior Analysis was the focus of the university students' educational program, and instruction on PECS implementation was a part of the university students' practicum training. The third phase of PECS, which was the focus of this study, was taught by the investigator.

PECS Materials

Initial PECS instruction began with 2 × 2 inch laminated pictures from a digital camera and Picture Communication Symbols® from Boardmaker for Windows (1995) with a small piece of Velcro® attached to the back of each picture. As the training progressed, three-ring binders (8½ inch × 5½ inch) with three strips of Velcro® attached were used as communication boards. Additional laminated pages were inserted, which contained extra picture cards.

Design

The design for this study was an alternating treatments within-subject design (Barlow & Hayes, 1979). A multiple-baseline design was not used as children began

PECS training immediately upon entering the program, and children started in the program at various times throughout the year.

The independent variable was the type of picture, either a picture symbol or a digital photograph. The outcome variable was measured by collecting data on the number of correct and incorrect picture discriminations made with symbols, and the number of correct and incorrect picture discriminations made with digital photographs during the third phase of the PECS training. A correct response was recorded when the child handed either type of picture representing the preferred item to the tutor independently when pictures of the preferred and non-preferred items were presented on the communication book, or when the child took the object that corresponded with the picture handed to the tutor. When any prompting, error correction procedures, or other assistance aided in the correct response, it was recorded as an incorrect response.

During baseline the trainer presented each student with an array of two highly preferred and two distracting items presented slightly out of the student's reach. Four corresponding pictures, both digital photographs and icons, attached with Velcro to a three-ring binder were within the child's reach. The student had 5 seconds to hand the trainer a picture that corresponded to a preferred item. If the child did not select a picture for exchange, this procedure repeated two additional times with new highly preferred items and pictures.

Procedure

The PECS training provided to each child followed the procedure outlined in the PECS training manual (Frost & Bondy, 2002). This study included the first three phases,

which consisted of the basic picture exchange, increasing distance, and picture discrimination. This study did not include the data from the last three phases of PECS. The phases stipulated in PECS followed the protocol developed by Frost and Bondy (2002). Criteria was correct responding at 80% or greater for two consecutive sessions. Table 1 provides a brief description of each phase of PECS.

Table 1

Description of Each Phase of PECS Training as Described by Frost and Bondy (2002)

Phase	Description
Reinforcer assessment	The child is offered a variety of food and items to determine which is the most reinforcing.
1. Basic picture exchange	The child is taught to approach an adult with a picture, give the adult the picture, and receive a preferred item. Two trainers are used for this phase, and the prompts are faded as the phase progresses.
2. Increasing distance	The child is taught to get a picture from his/her communication binder, approach an adult, and place the picture in the trainer's hand. The communication binder is moved away from the child, and the trainer moves further away from the child. Two trainers are used in this phase, and the phase is conducted in a variety of settings.
3. Picture discrimination	The child is presented with a preferred and non-preferred item, and corresponding pictures are placed on the communication board. At the end of the phase, the child is asked to discriminate between up to 5 pictures of preferred objects.

Stimulus Preference Assessment

The children participated in a preference assessment prior to PECS training, and twice a week throughout the training. The preference assessment was a multiple-stimulus-without-replacement (DeLeon & Iwata, 1996; DeLeon, Iwata, & Roscoe, 1997). The

preference assessment was conducted outside of each child's learning booth at a small table designated for the purpose of preference assessments. Six to eight items were presented in a horizontal line in front of each student. As students selected each item, they were allowed to play with or consume the item for 5 seconds, and the item was added to the students reinforcer bin. A brief assessment occurred before and within each PECS training session to determine the most highly preferred items. Additionally, the tutor offered favored foods during a brief assessment included in the PECS training. The pictures of preferred items were used with the corresponding objects during PECS training.

Baseline Probe

Following the preference assessment, students were presented with a three-ring binder with pictures of preferred and neutral items. The students were given 5 seconds to remove the picture of the reinforcing item that was available and hand it to the researcher. This was repeated for two trials for a total of 12 picture and item combinations.

PECS Training

The children participated in PECS training sessions two to three times per day at 10 trials per session during the regular school day. The children attended the school 5 days per week, 3 hours per day. Following a preference assessment, pictures that corresponded with the preferred items were used for PECS training trials. The selection of corresponding symbols or digital photographs alternated from one child to the next. For the first child, the picture of the most reinforcing item was a symbol; the picture of

the second most reinforcing item was a digital photograph; the picture of the third most reinforcing was a symbol; the fourth, a digital photograph, etc., until 10 items were selected. For the second child, the picture of the most reinforcing item was a digital photograph; the picture of the second most reinforcing item was a symbol, etc., as illustrated in Table 2. The digital photographs and picture symbols representing the preferred items were used during all three phases of PECS training.

Table 2

Assignment of Picture Type Based on Item Preference

Child	1st Preferred	2nd Preferred	3rd Preferred	4th Preferred
Child A	Symbol	Photograph	Symbol	Photograph
Child B	Photograph	Symbol	Photograph	Symbol
Child C	Symbol	Photograph	Symbol	Photograph
Child D	Photograph	Symbol	Photograph	Symbol

The training, based on the protocol developed by Frost and Bondy (2002), began by teaching the child to exchange a picture with a communication partner for a desired item. In this phase, one tutor presented the preferred item and accepted the picture from the child for the exchange as the communicative partner, and another trainer prompted the child from behind as needed to pick up the picture and present it to the communicative partner. By the end of Phase 1 the child picked up a picture, handed it to the communicative partner, and received the requested item.

The second phase required that the child remove the picture from a communication binder. The tutor moved away from the child and gradually increased the

distance between the child and the communication binder. A second tutor was used to guide the child to the communication book if needed. The tutor also looked away from the child as the child approached so the child had to touch the tutor or in some way get the tutor's attention before the trainer accepted the picture.

The third phase, which was the focus of this study, required the child to discriminate between two or more pictures placed on the communication board. Phase 3A consisted of placing the picture of a preferred item and a non-preferred or neutral item on the communication board with only the preferred item present. When the child handed the tutor the picture of the non-preferred or neutral item, it was an incorrect response, regardless of picture type, and an error correction procedure used. A correct response was recorded when the child handed the tutor picture of the preferred item selected, regardless of picture type. This step continued with prompting to criterion (80% for two sessions). Another aspect of this procedure was checking the correspondence between what a child selected via picture, and what he or she selected from a set of concrete reinforcing items. First two (Phase 3B1), then three (Phase 3B2), and finally five (Phase 3B3) pictures of reinforcing objects were on the child's communication board, and the corresponding objects were on a table in front of the child. After the child handed the tutor the picture, the tutor indicated that the child could take the item from the offered set. If the child did not take the object that corresponded to the picture handed to the tutor, it was an incorrect response and an error correction procedure was utilized (Appendix A). If the child took the object that corresponded to the picture, it was a correct response. This step was repeated and data were collected (Appendix B) until criterion was met (80% for two consecutive sessions).

Inter-observer Agreement

Supervising tutors had been trained in PECS and had over a year's experience implementing PECS and supervising and training PECS implementation with new tutors. Two supervising tutors independently coded a videotape of sessions, and the criterion for inter-observer agreement was set by the researcher at 80%. To calculate observer agreement, the number of agreements was divided by the total number of agreements plus disagreements, multiplied by 100 (Kazdin, 1982). Inter-observer agreement was calculated for at least 25% of the total observations for each child.

Analysis of Data

On each trial of the PECS training, the tutor recorded data. Data collected on Phase 3 of the PECS training answered the research questions. Data were plotted graphically to determine whether the data showed a causal relationship (Poling et al., 1995). The comparison was between the type of picture used (symbol or digital photograph), and the number of correct picture discriminations made by the participant.

Limitations and Anticipated Problems

The limitations of this study included the small number of participants, and replication with additional subjects was needed. An anticipated problem in conducting this study was that several of the tutors conducting the PECS training were university students who participated in the classroom for only one semester. This occasionally resulted in a tutor change before a child completed the third phase of PECS. When this

occurred, a classroom teacher or a senior supervising tutor previously trained in the PECS protocol, rather than a new, untrained tutor, completed the PECS training. An additional problem was that not all children reached criterion (80%) on Phase 3 of the PECS procedure. The data collection for the child ended if a child did not reach criterion on Phase 3 of the PECS procedure after 300 trials.

Summary

Chapter III described the foundation of the alternating treatments design and presented rationale for the use of the design in this study. The method, participants, settings, materials, design, and procedure were discussed. The chapter concluded with a description of inter-observer agreement, the analysis of data, and the limitations of the study. The results of the study are discussed in Chapter IV.

CHAPTER IV

ANALYSIS OF THE DATA

The current research used a single-subject alternating treatments design (Barlow & Hayes, 1979) to compare two picture types, picture icons and digital photographs, to determine which type of picture would result in more effective picture discrimination for young children with developmental disabilities. Data were collected on correct picture discrimination throughout training in the Picture Exchange Communication System (PECS). The design of this study was to answer the following questions:

$R_{1:}$ Does the use of digital photographs in PECS training result in a larger percentage of correct picture discriminations?

$R_{2:}$ Does the use of picture symbols in PECS training result in a larger percentage of correct picture discriminations?

A description of the data and analysis procedures is presented in this chapter. The chapter contains the following sections: (1) demographic description of subjects, (2) analysis of data, (3) summary of the findings, (4) overview of significant findings, (5) the two hypotheses, (6) reliability, and (7) a summary of the chapter.

Many researchers reported the use of augmentative and assistive communication (AAC) systems to improve communication skills (Bondy & Frost, 1994; Chambers & Rehfeldt, 2003; Charlop-Christy et al., 2002; Mirenda & Erickson, 2000). The Picture Exchange Communication System (PECS), one type of AAC, has been found effective in

providing individuals with ASD and other developmental delays a functional means of communication (Sulzer-Azeroff et al., 2009). However, the specific type of visual representation (pictures, symbols, line drawings, etc.) used with preschool children was not reported.

Demographic Description of Subjects

Four children from a center-based program for students with ASD and other developmental delays participated in the study. All children attended a special education preschool classroom that focused on early and intensive behavioral intervention. The multidisciplinary evaluation team of the school district determined that two students qualified for the label of ASD and two children were labeled ECDD based on the state definitions (see Chapter I for these definitions). The multidisciplinary team included a speech tutor, a school psychologist, a social worker, and an occupational tutor. The children ranged in age from 22 to 36 months. Three males and one female participated in the study. Two of the children were Caucasian, one child was Hispanic, and one child was African American (Table 3).

Table 3

Description of Study Participants

Student	Gender	Age	Race	Eligibility
A	Female	22 months	Caucasian	ECDD
B	Male	28 months	African-American	ASD
C	Male	36 months	Hispanic	ECDD
D	Male	24 months	Caucasian	ASD

The students all displayed delays in receptive and expressive communication (Table 4). The Preschool Language Scales–4 (PLS-4; Zimmerman, Steiner, & Pond, 2002), and/or the Toddler Speech/Language Checklist from the Infant/Toddler Developmental Assessment (IDA; Provence et al., 1995) were used by the multidisciplinary team as guidelines to assess the children's speech and language skills.

Table 4

Description of Participant Age and Language Equivalency

Student	Chronological Age	Receptive Age	Expressive Age
A	22 months	15 months	9 months
B	28 months	7–12 months	7–12 months
C	36 months	12 months	9 months
D	24 months	10 months	10 months

Based on the evaluation of each child by the assessment team, individual goals and objectives were developed as part of each child's Individual Education Plan. Several objectives addressed the children's language deficits, and the use of PECS and other icons to augment communication was included in teaching objectives established for the classroom and speech and language therapy (Table 5).

Analysis of Data

Single-subject methods were used to analyze the data and answer the research questions, i.e., whether the use of digital photographs or picture icons resulted in a greater number of correct discriminations in the third phase of PECS training. Data were plotted

graphically on line graphs to determine a causal relationship between the use of each picture type and the number of correct discriminations made by each child. The X-axis on the graphs indicates the PECS session number, and the Y-axis indicates the percentage of trials completed correctly in each session (Poling et al., 1995).

Table 5

Number of Individual Education Plan (IEP) Communication Objectives Developed Specifying Use of the Picture Exchange Communication System and/or Icons in IEP Objectives by Participant

Student	IEP Language Objectives	PECS Objectives	Icon Objectives	PECS/Icons Objectives
Student A	6	1	1	1
Student B	7	1	1	1
Student C	6	1	1	1
Student D	9	2	1	1

Summary of the Findings

Student A

Student A was a 22-month-old Caucasian girl with a cognitive age of 18–23 months. She had an expressive language age-equivalent score of 9 months on the Preschool Language Scales-4 (PLS-4; Zimmerman et al., 2002). Her receptive age-equivalency on the PLS-4 was 15 months. She was reported to have difficulty following directions and would sometimes throw herself backward and arch her back in anger. Student A was using five words, and to gain assistance or let someone know she wanted

an object, Student A typically whined, vocalized, produced the sign for “more,” or occasionally pointed to something out of reach. The multidisciplinary team noted several skills that Student A did not demonstrate during assessment, including leading an adult to what she wanted, seeking attention from others; demonstrating an auditory memory for pictures; matching an object to its picture; identifying objects, pictures, or body parts; babbling two repeated syllables; calling attention to her performance; waiting for her needs to be met; and initiating a turn-taking game or social routine. In summary, the multidisciplinary team found that delays in her receptive and expressive language were affecting her ability to communicate effectively with family, staff, and peers in social settings and her ability to express her wants and needs. The multidisciplinary team determined that Student A met the eligibility criteria of Early Childhood Developmental Delay (ECDD). Several IEP objectives were developed to address Student A’s language deficits, which included the use of PECS and other icons to augment her communication (Table 5). Based on the inclusion of PECS in her IEP, Student A was the first child selected to participate in this research study.

Results of PECS Discrimination for Student A

The percentage of correct picture discriminations made by Student A during the baseline probe was 0%. Phase 3A of the Picture Exchange Communication System (PECS) requires the student to discriminate between pictures of a preferred and non-preferred item. The percentage of correct discriminations made by Student A with digital photographs was 100%. The percentage of correct discriminations made with picture symbols was 90%. Phase 3B1 requires the student to discriminate between two pictures

of preferred items. The percentage of correct discriminations with digital photographs was100%, and the percentage of correct discriminations with picture symbols was 55%. Phase 3B2 requires discrimination between pictures of three preferred items. The percentage of correct discriminations made by Student A with digital photographs was 72%, and the percentage of correct discriminations with picture symbols was 95%. Phase 3B3 checks a student's ability to discriminate between pictures of five preferred items. The percentage of correct discriminations with digital photographs was 92% and the percentage of correct discriminations with picture symbols was 100%. Overall, the average number of correct discriminations made with digital photographs by Student A was 91%. The average number of correct discriminations made with picture symbols was 85%. The results for Participant A are provided in Table 6 and Figure 1.

Table 6

Percentage of Correct Responses by Picture Type for Student A

Phase	Digital Photograph	Picture Symbol
3A	100	90
3B1	100	55
3B2	72	95
3B3	92	100

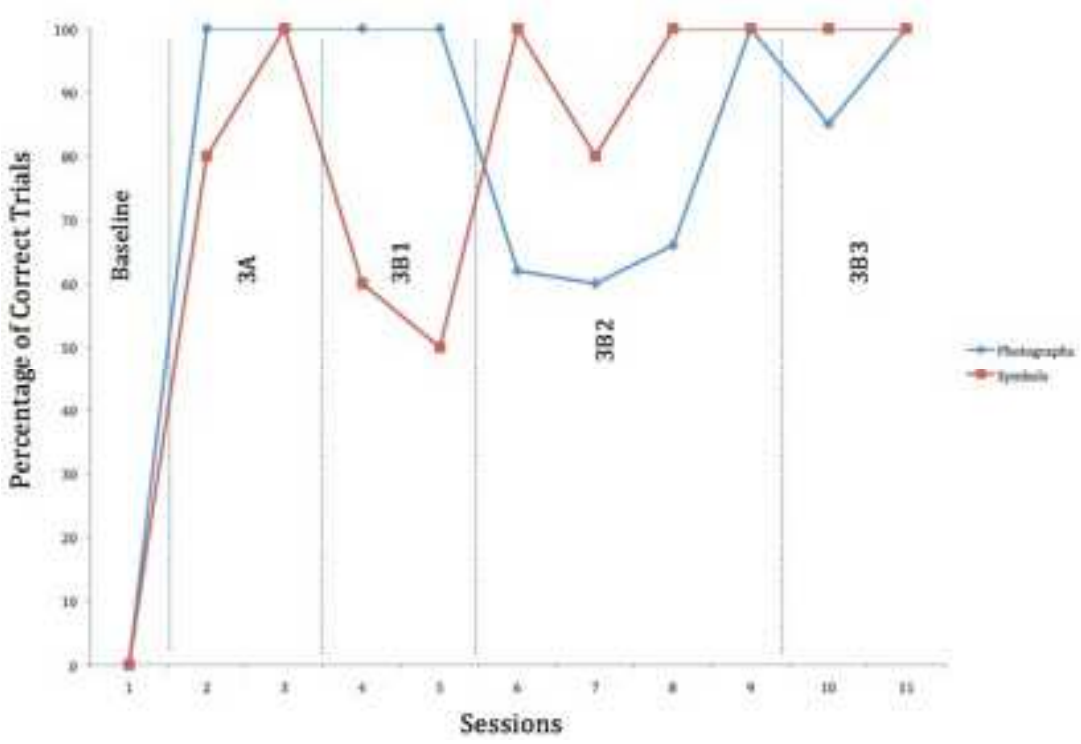

Figure 1. Effects of the use of two picture types in the percentage of correct discriminations in PECS Phase 3 for Student A.

Student B

Student B was a 28-month-old African-American boy with a cognitive age of 17–22 months. Results from the Birth to Three Test of Developmental Abilities (BTAIS-2; Ammer & Bangs, 2000) indicated that his overall receptive and expressive language skills were those typically seen in children 7 to 12 months of age. Student B did not use gestures in absence of speech other than pushing someone's hand or objects away to indicate he did not want something. Parents reported that he banged his head on the floor during his daily tantrums. During assessment he did not demonstrate an ability to respond to his name, follow one-step directions, attempt to activate novel toys, watch another

person's face for cues, complete a rotated three-piece form board, show awareness of other people, identify himself in a mirror, or use verbal or nonverbal means to express his wants and needs. The multidisciplinary team concluded that Student B's impairments were affecting his ability to participate in social activities, his play skills and independence, his ability to express himself and understand and process directions, and his ability to learn new skills. Student B met the special education requirements for ASD based on the state rules and regulations for ASD. To address his delays in communication, several IEP objectives were developed, which included the use of PECS and other icons to augment his communication (Table 5). Based on the inclusion of PECS in his IEP, Student B was the second child selected to participate in this research study.

Results of PECS Discrimination for Student B

The percentage of correct picture discriminations during made by Student B during the baseline probe was 0%. Phase 3A of the Picture Exchange Communication System (PECS) requires the student to discriminate between pictures of a preferred and non-preferred item. The percentage of correct discriminations made by Student B with digital photographs was 95%. Student B did not select any picture symbols during Phase 3A. Phase 3B1 requires the student to discriminate between two pictures of preferred items. The percentage of correct discriminations with digital photographs was 83%, and the percentage of correct discriminations with picture symbols was 41%. Phase 3B2 requires discrimination between pictures of three preferred items. The percentage of correct discriminations made by Student B with digital photographs was 100%, and the percentage of correct discriminations with picture symbols was 83%. Phase 3B3 checks a

student's ability to discriminate between pictures of five preferred items. The percentage of correct discriminations with both digital photographs and picture symbols was 100%. Overall, the average number of correct discriminations made with digital photographs by Student B was 94%. The average number of correct discriminations made with picture symbols was 75%. The results for Participant B are provided in Table 7 and Figure 2.

Table 7

Percentage of Correct Responses by Picture Type for Student B

Phase	Digital Photograph	Picture Symbol
3A	95	x
3B1	83	41
3B2	100	83
3B3	100	100

Note. A small x indicates Student B did not select picture symbols during Phase 3A.

Student C

Student C was a 36-month-old Hispanic boy with a cognitive age of 24–30 months. He had an expressive age-equivalency of 9 months on the BTAIS-2 (Ammer & Bangs, 2000). Student C had a receptive age-equivalency on the BTAIS-2 of 12 months. He had no words, and limited use of gestures, which included pointing and shaking his head "no." Student C had no functional communication system and was unable to verbally express his wants and needs. Parents reported that he had frequent temper tantrums when he was not understood, and he would throw his body back, bang his head

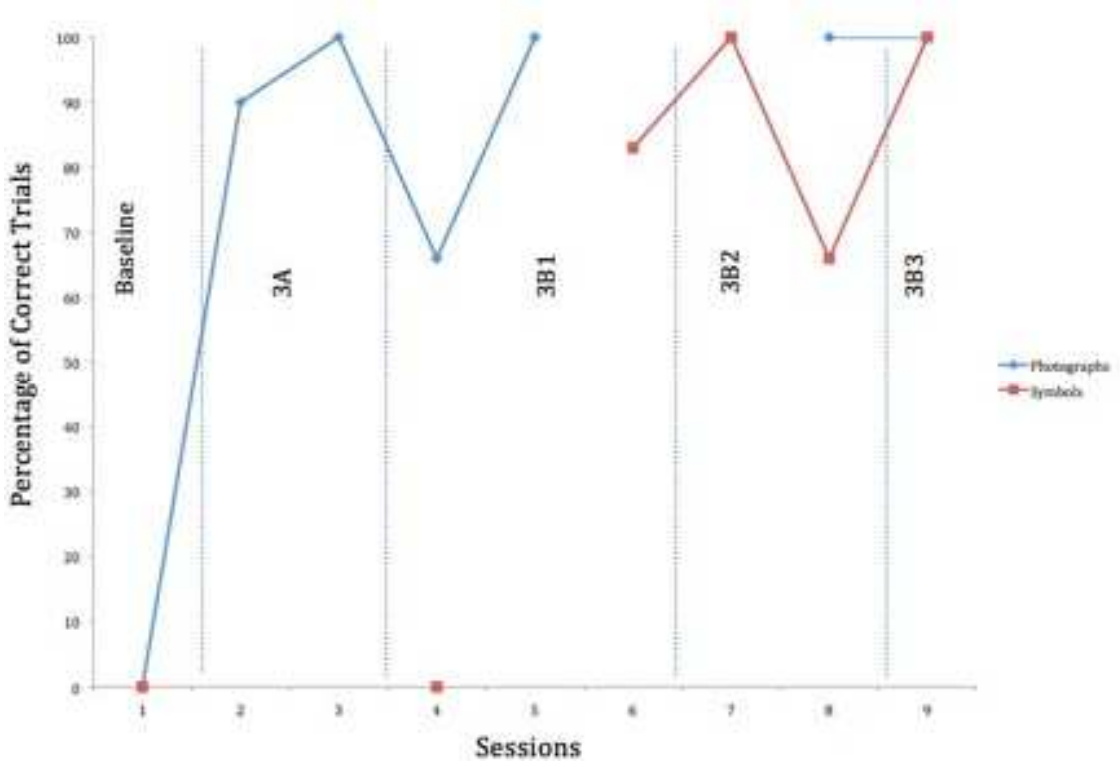

Figure 2. Effects of the use of two picture types in the percentage of correct discriminations in PECS Phase 3 for Student B.

on the floor, cry and scream. He did not recognize common objects or pictures of common objects, pull a mat to obtain an object, follow one-step directions consistently, respond with a yes/no response, or imitate sounds or words. He met the criteria for ECDD, and the multidisciplinary team determined that Student C's impairments were affecting his ability to understand and use language effectively, his level of independence, and his overall learning. To address his delays in communication, several IEP objectives were developed, which included the use of PECS and other icons to augment his communication (Table 5). Based on the inclusion of PECS in his IEP, Student C was the third child selected to participate in this research study.

Results of PECS Discrimination for Student C

The percentage of correct picture discriminations during made by Student C during the baseline probe was 0%. The percentage of correct discriminations made by Student C in Phase 3A with digital photographs was 75%. The percentage of correct discriminations made with picture symbols was 68%. Phase 3B1 requires the student to discriminate between two pictures of preferred items. The percentage of correct discriminations made by Student C with both digital photographs and picture symbols was 100%. Phase 3B2 requires discrimination between pictures of three preferred items. The percentage of correct discriminations made by Student C with digital photographs was 100%, and the percentage of correct discriminations with picture symbols was 87%. Phase 3B3 checks a student's ability to discriminate between pictures of five preferred items. The percentage of correct discriminations with both digital photographs and picture symbols was 100%. Overall, the average number of correct discriminations made with digital photographs by Student C was 94%. The average number of correct discriminations made with picture symbols was 89%. The results for Student C are provided in Table 8 and Figure 3.

Table 8

Percentage of Correct Responses by Picture Type for Student C

Phase	Digital Photograph	Picture Symbol
3A	75	68
3B1	100	100
3B2	100	87
3B3	100	100

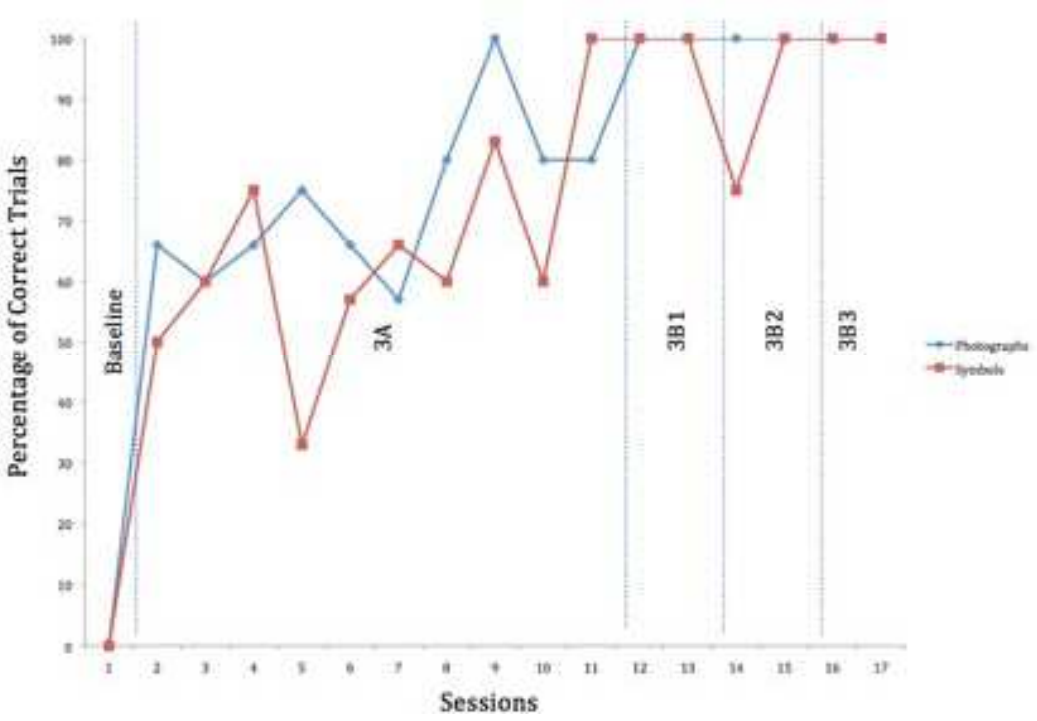

Figure 3. Effects of the use of two picture types in the percentage of correct discriminations in PECS Phase 3 for Student C.

Student D

Student D was a 24-month-old Caucasian boy with a cognitive age of 15 months. He obtained a receptive and expressive age equivalent score of 10 months. During his assessment by a multidisciplinary team, he vocalized when excited or distressed, and pointed one time at something he wanted. Parents reported that Student D had used approximations of eight words. Parents also reported that he became frustrated when he had difficulty communicating his needs and wants, prompting him to cry, throw himself on the floor, and hit or throw objects. He did not respond to his name; imitate motor activities, body motions, or vocalizations; name or point to pictures in books; play interactive games; or respond to his name. The multidisciplinary team concluded that his

delays affected his achievement of developmental milestones, his peer interactions, his ability to understand directions and requests, and his ability to express his wants and needs. Student D was eligible for special education services under the category of ASD based on the state guidelines for ASD. To address his delays in communication, several IEP objectives were developed, which included the use of PECS and other icons to augment his communication (Table 5). Based on the inclusion of PECS in his IEP, Student D was the fourth child selected to participate in this research study.

Results of PECS Discrimination for Student D

The percentage of correct picture discriminations during made by Student D during the baseline probe was 0%. Phase 3A of the Picture Exchange Communication System (PECS) requires the student to discriminate between pictures of a preferred and non-preferred item. The percentage of correct discriminations made by Student D both with digital photographs and picture symbols was 100%. Phase 3B1 requires the student to discriminate between two pictures of preferred items. The percentage of correct discriminations with digital photographs was 100%, and the percentage of correct discriminations with picture symbols was 93%. Phase 3B2 requires discrimination between pictures of three preferred items. The percentage of correct discriminations made by Student D with digital photographs was 100%, and the percentage of correct discriminations with picture symbols was 77%. Phase 3B3 evaluates a student's ability to discriminate between pictures of five preferred items. The percentage of correct discriminations with digital photographs was 67%, and the percentage of correct discriminations with picture symbols was 92%. Overall, the average number of correct

discriminations made with digital photographs by Student D was 92%. The average number of correct discriminations made with picture symbols was 90%. The results for Student D are provided in Table 9 and Figure 4.

Table 9

Percentage of Correct Responses by Picture Type for Student D

Phase	Digital Photograph	Picture Symbol
3A	100	100
3B1	100	93
3B2	100	77
3B3	67	92

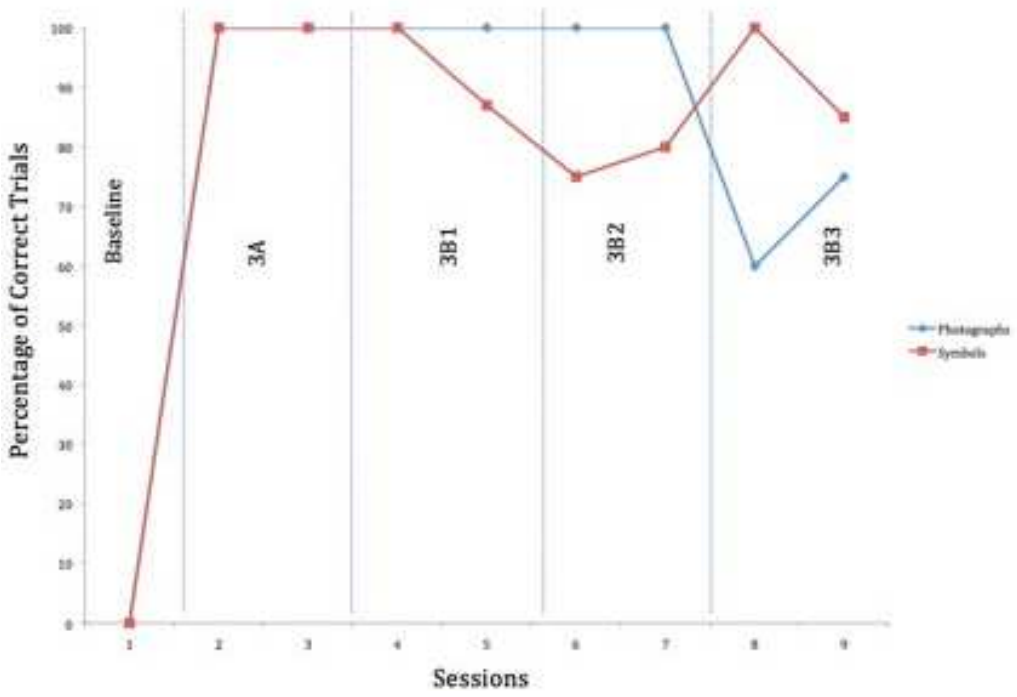

Figure 4. Effects of the use of two picture types in the percentage of correct discriminations in PECS Phase 3 for Student D.

Overview of Significant Findings

This investigation was designed to determine whether the type of picture used to teach the Picture Exchange Communication System (PECS) had an impact on the number of correct discriminations made by young children with ASD or ECDD. The review of literature presented in Chapter II indicated that the use of PECS was an effective communication system for students with disabilities (Bondy & Frost, 1994, 2010; Carr & Felce, 2007; Chambers & Rehfeldt, 2003; Charlop-Christy, 2002; Howlin et al., 2007; Kravits et al., 2002; Magialti & Howlin, 2003; Schwartz, Garfinkle, & Bauer, 1998; Sulzer-Azeroff et al., 2009; Webb, 2000), and compared well to other augmentative and alternative communication interventions including other picture-based systems and manual sign language (Chambers & Rehfeldt, 2003; Tincani, 2004). Research noted indicated increases in communicative initiation (Carr & Felce, 2007; Howlin et al., 2007; Kravits et al., 2002) and an increase in speech (Charlop-Christy et al., 2002; Ganz & Simpson, 2004; Yoder & Stone, 2006) following the PECS training. Though the documentation of the use of PECS as an effective means of communication for non-verbal children with disabilities has increased, information is lacking on the unique characteristics of PECS training that lead to successful acquisition of this method of AAC. There is a need to determine whether the visual nature of the symbols used in the PECS, specifically the degree of iconicity of the symbols, plays a crucial role in the ability of young children with ASD and other disabilities to discriminate between symbols as they learn to use the PECS to augment their communication.

The purpose of this study was to determine whether the type of picture used when teaching the Picture Exchange Communication System have an effect on the percentage of correct picture discriminations made by preschool children with Autism Spectrum Disorder and other developmental disabilities. A single-subject alternating treatments design was used to address the following two research questions:

$R_{1:}$ Does the use of digital photographs in PECS training result in a larger percentage of correct picture discriminations?

$R_{2:}$ Does the use of picture symbols in PECS training result in a larger percentage of correct picture discriminations?

The investigator did not reject the two research null hypothesis corresponding to the research questions above as the use of digital photographs or picture symbols did not result in a larger percentage of correct picture discriminations. Data were collected from the alternating treatments design which did not clearly indicate that either type of picture was less effective in correct picture discriminations by preschool children with disabilities.

Hypothesis One

The first null hypothesis was not rejected, which stated that the use of digital photographs in PECS training did not result in a larger percentage of correct picture discriminations. A visual examination of Figure 1 indicated that Student A did not make a larger percentage of correct picture discriminations with digital photographs. Her percentage correct was slightly higher with digital photographs (100%) than picture symbols (90%) on Phase 3A when she was discriminating between a picture of a

preferred and non-preferred item. Her percentage correct was also higher on Phase 3B1 with digital photographs (100%) than picture symbols (55%) when she was discriminating between two preferred items. However, Student A had a lower percent correct with digital photographs (72%) than with picture symbols (95%) when discriminating between pictures of three preferred items in Phase 3B2. Additionally, her percentage correct was somewhat lower with digital photographs (92%) than picture symbols (100%) on Phase 3B3 when discriminating between pictures of five preferred items (Table 6).

A visual examination of Figure 4 indicated that Student D did not make a larger percentage of correct picture discriminations with digital photographs. Student D made fewer correct picture discriminations when using digital photographs (67%) than with picture symbols (92%) in one phase of PECS (Table 9, Figure 4). This occurred during Phase 3A, which required the student to discriminate between a picture of a preferred and non-preferred item. In Phase 3A, Student D was equally proficient with both digital photographs and picture icons (100%). The number of correct picture discriminations made by Student D in the remaining two phases was greater with the use of digital photographs than with picture symbols.

Hypothesis Two

The second null hypothesis was not rejected, which stated that the use of picture symbols in PECS training did not result in a larger percentage of correct picture discriminations. Student B did not make a greater percentage of picture discriminations in three of the four subphases of Phase 3, and in one phase no picture symbols were selected

(Table 7, Figure 2). In Phase 3B3 when discriminating between digital photographs and picture symbols with pictures of three preferred items, his score was the same for each picture type (100%). His discrimination scores were greater for digital photographs (83%) than picture symbols (41%) in both Phase 3B1 and 3B2 (100% and 83%, respectively).

Student C also did not make a greater percentage of correct discriminations with the use of picture symbols than with the use of digital photographs (Table 8). As illustrated in Figure 3, Student C had slightly higher discrimination scores with picture symbols (75%) than with digital photographs (68%) in Phase 3A when discriminating between pictures of a preferred and non-preferred item. He also made a greater percentage of discriminations with digital photographs (100%) than with picture symbols (87%) on Phase 3B2. Student C was equally proficient with digital photographs and picture symbols in both Phase 3B1 and 3B3 (100%).

The focus of this study was to compare two types of pictures, digital photographs and picture symbols, in correct discriminations in Phase 3 of the Picture Exchange Communication System. Following training, all four participants were able to discriminate between five pictures of preferred items. The average number of correct discriminations made with digital photographs by Student A was 91%. The average number of correct discriminations made with picture symbols was 85%. The average number of correct discriminations made with digital photographs and picture symbols by Student B was 95% and 85%, respectively. The average number of correct discriminations made with digital photographs by Student C was 84%, and the average number of correct discriminations made with picture symbols was 72%. Overall, the average number of correct discriminations made with digital photographs by Student D

was 92%. The average number of correct discriminations made with picture symbols was 90%.

Reliability

Inter-observer agreement was collected on 38% of all sessions conducted in Phase 3 of PECS training. The results from each trial were compared to the data collected by the researcher and two supervising tutors who independently coded a videotape of sessions. The acceptable criterion for inter-observer agreement was 80% (Hersen & Barlow, 1976). To calculate observer agreement, the number of agreements was divided by the total number of agreements plus disagreements, multiplied by 100 (Kazdin, 1982). An agreement occurred when the researcher and both observers recorded the same score on each item. Inter-observer agreement should be calculated on at least 25% of all observations (Poling et al., 1995). Overall, 50% of Student A's sessions, 37% of Student B's sessions, 35% of Student C's sessions, and 37% of Student D's sessions were reviewed by two observers. Mean agreement scores in Phase 3 of PECS were 90% for Student A, 95% for Student B, 93% for Student C, and 80% for Student D. The level of inter-observer agreement was acceptable (Hersen & Barlow, 1976) for all four participants.

Summary

In Chapter IV, the researcher presented the results of the use of two picture types in training Phase 3 of the PECS. Tables and figures were included to provide clarity and to graphically determine whether the data showed a causal relationship between the type

of picture used and the number of correct picture discriminations made by the participant. From these data, the following emerged as the important findings of the study based on the use of single-subject alternating treatments design to compare the efficacy of two types of visual representations:

1. The use of digital photographs in PECS training does not result in a larger percentage of correct picture discriminations.

2. The use of picture symbols does not result in a greater percentage of correct picture discriminations.

In Chapter IV, the investigator described the demographics of the research participants, and an analysis and summary of the data for each participant. The researcher summarized the study's research questions and corresponding null hypothesis. Chapter V contains a review of the findings, the implications of the current study, the limitations of the research, and areas for further exploration.

CHAPTER V

SUMMARY AND CONCLUSIONS

The current study utilized a single-subject research design to compare the use of two types of pictures in PECS training. Correct discriminations with either digital photographs or picture symbols were recorded for four young children with ASD and related disabilities. A requirement of the third phase of PECS was visual discrimination between up to five pictures following successful acquisition of the picture exchange components of the first and second phase.

Chapter III contained a description of the demographics, analysis, and summary of the data for each participant. A description of the study methodology and reliability of the data was included. In Chapter IV, the researcher provided a discussion of the significant findings of the research. Chapter V will contain implications of the study in light of current research. The results of the study indicated that the type of picture used in PECS training did not significantly impact the participants' ability to discriminate between pictures in the third phase of PECS. The results were varied by subject and phase. Subjects were better able to discriminate with digital photographs in some phases, more successful with picture symbols in other phases, and in several phases the subjects were able to discriminate with both picture types with 100% accuracy. The limitations of the research and areas for further exploration are reviewed in Chapter V.

The participants in this study all learned to discriminate between pictures in Phase 3 of PECS. All learners were able to discriminate between five pictures of preferred objects in 16 sessions or fewer, which included a maximum of 160 learning trials. The research questions could have focused on specific subphases within Phase 3 to more clearly evaluate the effectiveness of digital photographs and picture symbols. For example, the participants' ability to discriminate between preferred and non-preferred pictures could have been compared to their ability to discriminate between several pictures representing preferred objects.

Consideration of the Findings in Light of Existing Research

This study added to the current body of literature concerning the PECS as a communication strategy for nonverbal children with disabilities. Researchers have demonstrated that the level of iconicity, or the degree to which a symbol resembles its referent, facilitates symbol learning for individuals with developmental disabilities (Koul et al., 2001). The degree of iconicity has also been reported to have an impact on young children's ability to extend labels between pictures and objects. Ganeau et al. (2008) reported that 15- and 18-month-old children are more successful at extending labels to objects when more realistic photographs or drawings are used than when less realistic cartoons are used. The researcher hypothesized that the iconicity of the pictures used to teach PECS to young children with disabilities would have an impact on the children's picture discrimination skills. In this study, the level of iconicity of the pictures used to teach PECS did not have an impact on the children's ability to discriminate between pictures. Three of the participants were able to discriminate correctly with 100% accuracy

with both digital photographs and picture symbols in at least one of the four components of the third phase of PECS. Additionally, two of the participants made a greater percentage of correct discriminations in at least one component of the third phase of PECS.

The findings of this research supported the results of a study conducted by Angermeir et al. (2007), which compared the use of pictures with higher iconicity ratings to those with lower iconicity ratings in training PECS. The researchers demonstrated that four children between the ages of 6 and 10 with Autism Spectrum Disorder were able to master Phase 1 and 2 of PECS with very little difference in accuracy between pictures. The first two phases of PECS did not specifically teach or test for discrimination between pictures; however, Phase 3 probes conducted by the researchers showed that while one learner achieved a greater percentage of correct responses with more iconic pictures, the results from the other three students were variable.

The minimal impact of the level of iconicity demonstrated by participants in the current research on PECS training may have been due to several factors. The literature stated that iconicity had an impact on symbol learning; however, the contrasting results of the current study may be based upon the nature of PECS training. In much of the literature on iconicity, the learner indicated a symbol by pointing to or touching the symbol in response to a trainer request. Learners exchanged a symbol as a request for a highly preferred object in the PECS, which may have explained the learners' ability to discriminate between pictures regardless of iconicity (Angermeir et al., 2007; Ganz & Simpson, 2004). Reichle et al. (1991) suggested that the reinforcing value of an object could be directly related to how quickly a student learned the (sign) symbol for that

object. All the pictures and symbols selected for this study reflected reinforcing objects selected by the participants.

Implications for Educational Practitioners

The results of this study have positive implications for educational practitioners. The learners in this study acquired and were able to discriminate between less iconic pictures and more iconic pictures at similar rates. This indicated that practitioners could expect the same positive results when teaching PECS with less iconic pictures. Attempts to select or create pictures that closely resemble their referent and the difficulty producing the pictures for PECS training had been reported as a disadvantage of PECS (Stoner et al., 2006; West, 2008). Frost and Bondy (2002) suggested using symbols that were initially the easiest to create or those already at hand, including less iconic pictures. Furthermore, A. S. Bondy (personal communication, January 29, 2010) reported that when digital photographs were used, some learners focused on particular features, such as the size of the object depicted in the photograph, the perspective of the picture, the angle of lighting, etc. It has been recommended that practitioners use an electronic software program such as Boardmaker, the software program used to create the picture symbols in this investigation, to produce pictures for PECS training (Stoner et al., 2006). The use of electronic software may reduce the time and effort required to make more iconic pictures such as digital photographs (Frost & Bondy, 2002; Stoner et al., 2006). Using less iconic pictures during initial PECS training may also facilitate generalization (Angermeir et al., 2007). Improving the ease of PECS training and implementation may contribute to increased use of this effective AAC system.

Limitations

Limitations of this study must be acknowledged. The current research was limited by threats to internal validity common to single-subject research. This includes events that may impact the intervention, including history and maturation (Kazdin, 1982). History included personal crisis or significant changes that occurred during intervention. The researcher observed the study participants on a daily basis during the school week, was in regular contact with the student's families, and was unaware of any factors that may have impacted the outcome of this study. Maturation included normal growth and development (Kazdin, 1982). The current research did not control for maturation. Due to illness, one student was involved in the study for 3 months, and improvements in his ability to discriminate may have been due to some level of maturation. However, the results of his intervention were similar to the results obtained with the other three students. It is unlikely that maturation had an impact on the participants' ability to discriminate between pictures as the intervention time span ranged from 3 to 30 days.

One anticipated problem in conducting this study was that the tutors conducting the PECS training were university students, many of whom changed each semester. This occasionally resulted in a tutor change before a child completed the third phase of PECS. All tutors received PECS training during their university seminars over the course of their first semester of participation in the classroom. Due to this limitation, the researcher conducted all training in Phase 3 of PECS. It is unknown whether PECS training in Phase 3 conducted by new tutors would have had an impact on the participants' ability to discriminate between pictures.

The participants in this study were not actively recruited and were selected based on specific criteria. Participants were nonverbal or used fewer than 10 words, gestures, or signs and had not had any previous experience with the PECS to be included in this study. Children between 18–36 months of age were selected. An educational diagnosis of ASD or ECDD and referral to the intensive early behavioral intervention program was also required for participation in this investigation. The first four children entering the program that met the criteria for this research and received parent permission for participation were the learners in this study. An additional problem encountered in this research was the long duration of participant enrollment, which spanned over a year. The rate of participant acquisition of the first two phases of PECS was also longer than anticipated, ranging from 2 months to almost 11 months. Regularly scheduled school program and university program breaks, student absences, and a change in school location may have all contributed to the extended acquisition time.

The researcher played multiple roles in the PECS intervention for each participant, which could be interpreted as both a strength and weakness of this study. First, the researcher was the special education teacher in the classroom research setting. In this position, the researcher supervised the practicum tutors who participated in the intensive early behavioral intervention program and monitored PECS training with the research participants on the first two phases of PECS. Second, the researcher conducted training on the third phase of PECS. The high level of inter-observer agreement (80–95%) established the accuracy of the data collected. The children in this investigation were diagnosed by the school district's multidisciplinary team. After the children were referred to the classroom program, the researcher played a third role in PECS

implementation by joining the team to determine goals and objectives for each child's IEP. All children participating in the intensive early behavioral intervention program had similar communication delays; consequently, PECS was included in every child's IEP goals and objectives. The inclusion of IEP goals and objectives that specified PECS training was not unique to the study participants.

A final limitation of this study is that data on the number of trials to acquisition for each participant in the first two phases of PECS were not reported. This additional information may have shed light on any correlation between the participants' ability to learn the basic picture exchange and distance and persistence phases of PECS and their ability to learn to discriminate between pictures in the discrimination phase of PECS.

Future Exploration

The results of the current research indicate that the level of iconicity of the pictures used in PECS training had limited impact on the ability of four preschool children diagnosed with ASD or ECDD between the ages of 22–36 months to discriminate between pictures in the third phase of PECS. Replication of this study is recommended to determine the external validity of the research (Kazdin, 1982). Additional research with students of varying ages and disabilities is also recommended.

An additional area for further exploration is the level of iconicity of the pictures selected for PECS instruction. The digital photographs and picture symbols used in the current study were both color pictures. It is not known whether black and white symbols, which are less expensive to produce, would have been equally effective.

Conclusions

There has been a substantial increase in the number of young children diagnosed with ASD and ECDD (Centers for Disease Control, 2009). Children with ASD and other developmental delays experience difficulties in language acquisition (Haile & Meaden, 2007; Wetherby et al., 2000), and many do not adequately communicate their needs before receiving intervention (U.S. Department of Education, 2009). Indeed, delays in language are often the initial reason for parent concern when pursuing an educational diagnosis for their child (Ventola et al., 2007). Acquisition of the most basic communication skills could have a tremendous impact on a child and everyone involved in their daily interactions, allowing them to have more control of their environment (Goldstein, 2002).

The use of AAC to improve communication skills for people with ASD and other developmental delays has been established (Bondy & Frost, 1994; Chambers & Rehfeldt, 2003; Charlop-Christy et al., 2002; Mirenda & Erickson, 2000). One form of AAC, the PECS, developed by Bondy and Frost (1994), has been used effectively with this population (Schwartz, Garfinkle, & Bauer, 1998; Sulzer-Azeroff et al., 2009; Tincani, 2004). PECS teaches learners to exchange a picture to obtain a preferred item, and the third phase of PECS focuses on discrimination between pictures.

The current study investigated the effects of the use of two picture types in picture discrimination during the third phase of PECS. As described throughout the manuscript, four preschool children diagnosed with ASD or ECDD between the ages of 22–36 months were able to successfully discriminate between up to five pictures of reinforcing

objects when using either digital photographs or picture symbols. The level of iconicity did not adversely affect the participants' percentage of correct discriminations. Based on these preliminary findings, we can surmise that the use of less iconic pictures can be used to teach PECS. Less iconic pictures are often less expensive to produce and do not require additional leaner instruction to generalize from pictures with a higher degree of iconicity. It is hoped that with this knowledge educational practitioners will more effortlessly implement this effective AAC system for persons with disabilities.

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Appendix A

Error Correction Procedure

Error Correction Procedure

Step	Teacher	Student
Teacher-Entice with both items		
Student-Gives picture		
Teacher-Says “Take it”		
Student-Reaches for wrong item		
Teacher-Block access		
Teacher-Model/Show		Point to, tap correct picture
Teacher-Prompt		Hold open hand near target picture
Student-Gives target picture		
Teacher-Praise (do not give item)		
Teacher-Switch		Cover book or “do this”
Student-Performs switch		
Teacher-Repeat		Entice with both items
Student-Gives picture		
Teacher-Say “take it”		
Student-Takes correct item		
Teacher-Allow access and praise		

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Appendix B

The Picture Exchange Communication System
Phase 3-Discrimination Data Sheet

Picture Exchange Communication System
Phase 3-Discrimination Data Sheet

Student:

Record number of preferred (p) or non-preferred/neutral (n) items offered. Record whether selected picture is a digital photograph (D) or a picture symbol (S). Record a correct or incorrect discrimination

	D/S	**+/-**	**D/S**	**+/-**	**D/S**	**+/-**	**D/S**	**+/-**	**D/S**	**+/-**
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

	D/S	**+/-**	**D/S**	**+/-**	**D/S**	**+/-**	**D/S**	**+/-**	**D/S**	**+/-**
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Appendix C

Parent Approval for Research Participation

Western Michigan University

Special Education and Literacy Studies

Principal Investigator: Sarah Summy
Student Investigator: Carmen Jonaitis
Title of Study: The Picture Exchange Communication System: Digital Photographs Versus Picture Symbols

Your child is being invited to participate in a research project. The title is "*The Picture Exchange Communication System: Digital Photographs versus Picture Symbols.*" This project will serve as Carmen Jonaitis' dissertation for the requirements of the Doctorate of Education. This form will explain why we are doing this study, and how we hope it will help your child communicate. It will explain how much time is involved and how we are doing the study. The form will also explain the risks and benefits of your child being in this research project. Please read this consent form carefully and completely. Please ask any questions if you are not sure about anything.

You are receiving two copies of this form. One is for you to keep, and the other is for you to sign and return to school if you give permission for your child to be in this study. You may send the signed copy in your child's home/school notebook.

What are we trying to find out in this study?
In your child's IEP, we talked about how hard it is for your child to communicate. We talked about how we teach children to use pictures to let us know what they want. The way we teach children to use pictures is called the Picture Exchange Communication System or PECS. While we are teaching your child PECS we will look at what kind of pictures is easiest for your child to use. We will carefully compare how well your child can make choices with pictures. The pictures will be digital photographs taken with a camera and picture symbols made from a computer. We currently use a combination of both to teach PECS in the classroom. We have never looked closely at which type of picture is the most effective. Half of the pictures of your child's favorite toys and food items will be digital photographs, and half will be picture symbols. We will write down which type of picture your child picks the most often. We will then determine which one works best when your child makes choices. Everything else about your child's PECS training will remain the same. The training will be conducted by a classroom teacher or his/her regularly assigned classroom tutor. Your child will receive PECS training whether or not you choose to participate in this study. The only difference will be that we will not carefully switch or keep track of the type of pictures your child uses correctly.

Who can participate in this study?
Children who have autistic like behaviors or Autism Spectrum Disorder can be in this study. We will include children between the ages of 18 and 36 months, who do not talk or say less than 5 words. We will only include children that just started in the Discrete

Trial Classroom at Croyden Avenue School. We will only include children who have not had training in the Picture Exchange Communication System (PECS).

Where will this study take place?
This study will take place in the discrete trial classroom at Croyden Avenue School.

What is the time commitment for participating in this study?
We will run this study during the times your child is learning PECS. Teaching your child to use PECS is part of the Individualized Education Plan (IEP). PECS training is will be in your child's schedule with other goals like eye contact or imitation. Your child will learn PECS 2-3 times per day. We will practice about 10 times every time we teach PECS.

What will your child be asked to do if you choose to participate in this study?
At your child's IEP we talked about teaching your child PECS. We will try to teach your child to give an adult a picture of a favorite food or object. The adult will then give your child the food or object your child chose. Half of the pictures will be photographs, and half of the pictures will be pictures from a computer. We will help your child give an adult a picture if your child doesn't understand.

Your child does not have to be in this study. If your child doesn't want to be in the study it is all right, and we will still teach your child the same information. We want to find out how your child learns PECS the best. Then we will teach your child the rest of PECS using the pictures your child learns the best. This may help your child learn new pictures faster, and improve his/her communication. This information might help all children learning to use PECS to communicate.

We will not use your child's name on any report about this study. If we use the results from this study in a report we will give your child a number. Once we have the information and the results, we will throw away the paper with your child's name on it. We will keep all the forms about the study for 3 years.

The only risks to this study is the possible frustration your child usually feels when your child learns something new. We will teach the same during this study as we do during regular classroom teaching. As in all research, there might be risks that we don't know about. If your child gets hurt during this study we do the same things we would do at any other time during the school day.

You can change your mind at any time if you decide you do not want your child to be in this study. We will still try to teach your child PECS along with your child's other IEP goals. Call Carmen Jonaitis at (269) 373-5775 or Sarah Summy at (269) 387-5943 if you have any questions. You can also call the chair of the Human Subjects Institutional Review Board at 269-387-8293. You can also contact the vice president for research 269-387-9298.

This form has been approved for use for one year by the Human Subjects Institutional Review Board. The stamped date and signature of the board chair in the upper right corner. Do not let your child be in the study if the stamped date is more than one year old.

Your signature below indicates that you, as parent or guardian, can and do give your permission for _____ *(child's name)* to participate in this research.

_____		_____
Signature		Date
Permission obtained by:	_____	_____
	initials of researcher	Date

Appendix D

Human Subjects Institutional Review Board
Letter of Approval

WESTERN MICHIGAN UNIVERSITY

Human Subjects Institutional Review Board

Date: November 24, 2009

To: Sarah Summy, Prihcipal Investigator
Carmen Jonaitis, Student Investigator for dissertation

From: Amy Naugle, Ph.D., Chair Amy Naugle

Re: HSIRB Project Number: 09-09-31

This letter will serve as confirmation that your research project titled "Picture Exchange Communication System: Digital Photographs versus Picture Symbols" has been **approved** under the **full** category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

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

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

Approval Termination: October 21, 2010

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