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Identifying an Optimal and Early Communication Modality for Students with Autism and Intellectual Disability

Daniel Brian Curtis
Lehigh University

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Identifying an Optimal and Early Communication Modality for Students
with Autism and Intellectual Disability

by

Daniel B. Curtis

Presented to the Graduate and Research Committee

of Lehigh University

in Candidacy for the Degree of

Doctor of Philosophy

in

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Date

Dissertation Advisor

Accepted Date

Committee Members:

Dr. Christine Cole, Committee Chair

Dr. Linda Bambara, Committee Member

Dr. William Galbraith, Committee Member

Dr. Lee Kern, Committee Member

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ABSTRACT

Research evaluating augmentative and alternative communication (AAC) options shows general support for various strategies (e.g., manual sign, picture exchange) in teaching individuals with autism (ASD) and intellectual disabilities (ID) to request basic wants and needs. However, the overall quality and quantity of research is diluted by the diversity within and between theoretical approaches to communication, participant characteristics, interventions, and outcomes measured. The increased frequency of literature reviews and meta-analyses conducted over the past 6 years substantiates the need to answer fundamental questions surrounding the prescriptive use of various AAC options, and the lack of clear and objective guidelines for practitioners to make informed educational decisions. Specifically, few comparative studies have evaluated AAC options for early communicators with ASD or ID, and fewer focus the comparison on the mode of communication by controlling for methodological differences. Moreover, no studies have conducted these efforts within the school setting with education personnel implementing the interventions. This study addressed the question of whether a single intervention methodology would enable educators to make informed decisions regarding an optimal mode of communication for early communicators with ASD and ID. A single-subject alternating treatments design with a baseline phase and generalization probes was used to compare the effectiveness and efficiency of manual sign and picture intervention on the acquisition of requests and speech production of four children with ASD and/or ID. Consistent with prior research, results were mixed across participants, with higher independence using picture requests across participants and better vocalizations of manual sign requests for one participant. An optimal mode of communication was identified for three of four participants. With two hours of training and weekly consultation, intervention teams successfully collected data and implemented procedures with high intervention integrity and adequate interobserver agreement. Overall, this study replicates the idiosyncratic fit between different AAC options and individuals with ASD and ID, while extending the literature by suggesting that educators can empirically evaluate these effects to make informed decisions for individual students. Specific findings and limitations of this study are discussed along with implications for future research and practice.

CHAPTER 1

STATEMENT OF THE PROBLEM

According to 2012 statistics provided by the U.S. Department of Education's National Center for Education Statistics (USDE-NCES), the number of children, ages 3 to 21 years old, which were identified with Autism Spectrum Disorders (ASD) increased twelve-fold from the 1995-96 school year to 2008-09 school year. During this same period, the percentage distribution of students with ASD served under the Individuals with Disabilities Education Act (IDEA) increased from 0.5% to 5.2%, and the number served as a percent of total enrollment increased from 0.1% to 0.7% (USDE-NCES, 2010). During the 2008-09 school year, students with developmental disabilities, including ASD and intellectual disabilities (ID), represented approximately 18.1% of all children served under the IDEA (USDE-NCES).

ASD is a developmental disability significantly affecting both communication and social interaction. In the United States, 41% of all individuals with ASD have cognitive impairments (Center for Disease Control- Morbidity and Mortality Weekly Report, 2009). Many students with ASD and ID are nonverbal and lack adequate functional communication skills. In fact, sources estimate that one-third to one-half of children with ASD are currently, and will remain, functionally mute (Charlop & Haymes, 1994; Mirenda, 2003; National Research Council, 2001).

Many individuals with ASD also experience severe deficits in social interaction (Stevenson, Krantz, & McClannahan, 2000) and often fail to initiate or respond to joint attention bids to share experiences and objects (Landa, 2007). Learning to communicate effectively is an important goal of education for young students with ASD and ID (National Research Council, 2001; Palmer & Wehmeyer, 2003; Sands & Doll, 1996). As a result, students with ASD and ID require extensive instruction and supports in a variety of areas, some of which include functional communication, navigating common social situations (National Research Council, 2001), self-determination (Field, Martin, Miller, Ward & Wehmeyer, 1998), and use of augmentative and alternative communication strategies.

Functional Communication Training

Functional communication skills are important for a number of reasons, but for students with ASD and ID in particular, substantial evidence exists to suggest that limited ability to communicate may result in the occurrence of challenging behavior. Conceptually, actions labeled as “challenging behavior” or “problem behavior” may actually originate from a breakdown in communication between a student and the adults who often control the environment. One of the first investigations involving the use of functional communication training (FCT) by Carr and Durand (1985) taught four children with developmental disabilities to use communicative phrases as functional substitutes for challenging behavior (aggression, self-injury, disruption). Immediate decreases in challenging behavior were observed once communicative phrases were learned. Subsequently, a number of studies have demonstrated that individuals with ASD and ID can learn functional communication skills and, consequently, exhibit lower levels of challenging behavior such as self-stimulation, self-injury, tantrums and aggression (Anderson, 2001; Charlop-Christy et al., 2002; Doss & Reichle, 1989; Durand & Carr, 1991; Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998; Koegel, Koegel, Hurley, & Frea, 1992; see also reviews by Mancil, 2006; Mirenda, 1997).

The implications of reducing challenging behaviors include teaching individuals to advocate for their own wants and needs through socially appropriate behaviors, reduced frustration for both students and adults, and increased time for instruction and educational programming. In addition, research indicates that language ability is a reliable predictor of social, cognitive, and academic performance (Carson, Klee, Perry, Donaghy & Muskina, 1997; Rutter, Greenfield & Lockyer, 1967). Because long-term positive outcomes for individuals with ASD and ID are highly correlated with the acquisition of functional communicative abilities (Koegel, Koegel, Yoshen, & McNeerney, 1999), the ability to advocate appropriately for one’s basic wants and needs is fundamental in building self-determination and therefore a critical target in the educational programs of students with ASD and ID, and may be a key component of self-determination.

Self-Determination

Sands and Doll (1996) contend that facilitating skills of self-determination is a developmental task, citing research that individuals with disabilities are more likely to exhibit an external locus of control in matters of choice making and decision making than their non-disabled peers and to defer to adults to manage academic or daily tasks (Field et al., 1998). Although the goals of most special education services are to promote independence and empowerment, and to provide specialized instruction, current barriers exist, in that many major life decisions are often made by adults (Snyder, 2002). These barriers inhibit the ability of students to practice and ultimately achieve self-determination skills such as self-management, self-advocacy, and choice making (Snyder, 2002). Researchers suggest that the current educational service delivery model for students with disabilities contains an inherent belief that these children cannot make appropriate choices in their lives (Clark, Olympia, Jensen, Heathfield, & Jenson, 2004) and incorporates instructional approaches that perpetuate dependency, automate choices, and undermine self-awareness (Blum, Lipsett, & Yocom, 2002). Van der Meer, Sigafoos, O'Reilly, and Lancioni (2011) addressed the topic of choosing one's own communication strategy in their review of assessment strategies for individual preferences for AAC options. Their findings indicated limited but promising efforts in recent studies to assess and consider individual preference for AAC options as part of the decision-making process.

Field, Martin, Miller, Ward, and Wehmeyer (1998) identified that communicating choices and self-advocacy are important skills, in the development of self-regulated, autonomous behavior. Literature has emphasized the need to provide instruction and opportunities to promote self-determination early in life to prepare students with disabilities to be self-determined in the world after school (Sands & Doll, 1996; Palmer & Wehmeyer, 2003). One of the key components of self-determination is the ability to communicate one's wants and needs. Individuals with ASD and ID need to develop adequate functional communication skills so they are able to make their desires known and advocate for their preferences. When communication breakdowns lead to challenging behaviors, it is important for adults to recognize the need to develop appropriate communication, not merely compliant behavior. If students are able to

effectively assert their preferences and communicate them, adults can become agents to facilitate fundamental skills in choice making and self-advocacy, ultimately working toward the life-long development of self-determination. Although communication is a comprehensive set of skills and should ultimately extend beyond asking for basic wants and needs (Ostry, Wolfe, & Rusch, 2008), critical elements of early communication instruction include capturing the child's motivation and providing both immediate and specific reinforcement (Bondy, Tincani, & Frost, 2004; Michael, 1985; Schlosser & Sigafoos, 2006; Sundberg, 1993) to develop a reliable communicative behavior.

Augmentative and Alternative Communication Strategies

Since the 1970's, research has documented the use of AAC strategies to address communication deficits in individuals with developmental disabilities including ASD and ID. Two primary dimensions of AAC can be classified based on the use of materials or equipment (aided vs. unaided) and the form of response required (topography-based or selection-based). Aided AAC strategies use external aids or devices (e.g., picture icons or vocal output devices) while unaided AAC strategies use only the individual's body to speak or produce signs or gestures (Schlosser & Sigafoos, 2006). In addition, topography-based (TB) systems require different responses for each referent (speech, sign) while selection-based (SB) systems use a generalized response form (pointing to or exchanging a picture stimulus) following the selection of the specific stimulus associated with its referent. Most AAC strategies can currently be classified as either aided, SB systems or unaided, TB systems

A variety of AAC strategies have been employed that include, but are not limited to, picture-point systems (individual points to a picture while communicative partner jointly observes), picture exchange systems (individual exchanges a picture with communicative partner), Vocal Output Communication Aids (VOCA in which a switch or display is operated/selected to provide voice output), and manual sign training (individual gestures using hand signals). Numerous studies and literature reviews have documented general support for the use of AAC strategies in teaching basic receptive and expressive skills to individuals with developmental disabilities (Bonvillian, Nelson, & Rhyne, 1981; Ganz, Earles-Vollrath et al., 2012; Goldstein, 2002; Hart &

Banda, 2010; Machalicek, O'Reilly et al., 2008; Millar, Light, & Schlosser, 2008; Miranda, 2001; Miranda, 2003; Preston & Carter, 2009; Schlosser & Blischak, 2001; Schlosser & Lee, 2000; Schlosser & Sigafoos, 2006; Tien, 2008; Tincani & Devis, 2011).

The two most popular AAC strategies are picture-based systems and manual sign training. Specifically, picture-based systems have included picture-point systems, the Picture Exchange Communication System (PECS: Bondy & Frost, 2002), and less formalized exchanged-based communication strategies (EBC), all of which are characterized by aided communication techniques and a stimulus selection-based requirement for the learner. Manual sign, in contrast, is characterized by unaided communication techniques with a topography-based requirement for the learner. Historically, topography-based strategies have been defined as those that require the learner to discriminate among and perform different actions (e.g., fine motor sequences of the hand for manual signs or the larynx for vocalizations) uniquely corresponding to particular communication targets (Michael, 1985). The majority of AAC research has evaluated one of these two techniques.

Picture-based systems

Several studies have shown support for the use of picture-based systems with children (Buckley & Newchok, 2005; Gregory, DeLeon, and Richman, 2009; Hamilton & Snell, 1993; Sigafoos, 1998; Stiebel, 1999) and adults (Reichle & Brown, 1986; Rotholz, Berkowitz & Burberry, 1989; Vaughn & Horner, 1995). For example, Hamilton and Snell (1993) used a milieu approach to increase the use of a communication book for a 15-yr-old boy with ASD and severe ID across four different school and home environments. After an average of 12 weeks of training in each environment, the participant met criteria for using his book during 75% of all opportunities. These skills were maintained after 1 year, with no problem behaviors 2 years after intervention. One major limitation of picture-point systems is that an adult's joint attention is required at the moment the request is made, which creates logistical challenges and persistence of the learner when attention is not available and pointing responses are not received.

Over the past 20 years, the use of picture-based communication systems has become dominated by the PECS strategies that were initially developed by Bondy and Frost (1994). A

number of early investigations (Bondy & Frost, 1993; Schwartz, Garfinkle & Bauer, 1998) spurred a number of recent investigations with more rigorous methodology and design to support the effectiveness of the PECS in teaching requesting/manding skills to children with ASD (Anderson, 2001; Charlop-Christy et al., 2002; Ganz, Heath, Rispoli, & Earles-Vollrath, 2010; Ganz, Parker, & Benson, 2009; Ganz & Simpson, 2004; Ganz, Simpson, & Corbin-Newsome, 2008; Howlin, Gordon, Pasco, Wade, & Charman, 2007; Kravits, Kamps, Kemmerer, & Potucek, 2002; Tincani, 2004; Tincani, Crozier, & Alazetta, 2006; Yoder & Stone, 2006a, 2006b) or adults with severe/profound disabilities (Chambers & Rehfeldt, 2003).

Ganz and Simpson (2004) taught three vocal children (ages 4-7), one with ASD and two with developmental delays and characteristics of ASD to use the PECS within a natural school setting. A single-subject, changing criterion design with the PECS training (Phases I-IV) was implemented for 2-5 sessions per week, 15 trials per session. Mastery through Phase IV averaged 23 sessions (range of 20-29 sessions) and 346 trials (range of 292-447 trials). All three participants showed increased vocalizations and one student generalized to other activities and adults. Several limitations included the disability category of PDD and pre-existing vocal skills, which suggest that while students possessed limited functional speech, they were higher functioning relative to participants in other studies. Additional limitations existed in data collection procedures, study design, and lack of intervention integrity data. Despite these limitations, this study provides additional empirical support for the use of the PECS to teach manding/requesting and facilitate vocalizations.

Howlin et al. (2007) provided the only group study specifically looking at PECS efficacy, but focused on teacher training and consultancy in the PECS rather than specific PECS procedures. Teachers attended a two-day PECS training and then received six support trainings, one half a day each, from expert consultants over 5 months. Results indicated immediate effects of the PECS usage but no effects on collateral measures of speech, language, or autism characteristics rated by the ADOS. However, intervention effects were not maintained once intervention ceased. A number of reviews of the literature suggest the evidence is emerging and currently the PECS can be considered a moderately effective intervention regardless of

participant diagnosis, age, gender, or highest phase of PECS mastered. However, further support is needed to replicate and bolster the evidence for the PECS in terms of speech outcomes, generalization, and maintenance (Ganz et al., 2012; Hart & Banda, 2010; Preston & Carter, 2009; Tien, 2008; Tincani & Devis, 2011).

Manual sign training and total communication training.

Over the past 40 years, a range of empirical support has shown manual sign training to be a viable AAC strategy although many studies initially looked at packages including total communication (verbal modeling and feedback) or different aspects of instruction (using general or specific reinforcement to teach manual signs). Early research found support for the use of manual sign training in teaching expressive and receptive language skills for children with ASD (e.g., Barrera, Lobatos-Barrera, & Sulzer-Azaroff, 1980; Barrera & Sulzer-Azaroff, 1983; Benaroya, Wesley, Ogilvie, Klein, & Clarke, 1979; Benaroya, Wesley, Ogilvie, Klein, & Meaney, 1979; Bennet, Gast, Wolery, & Schuster, 1986; Brady & Smouse, 1978; Carr, Kologinsky & Leff-Simon, 1987; Carr, Pridal & Dores, 1984; Kouri, 1988; Layton, 1988; Layton & Baker, 1981; Miller & Miller, 1973; Mirenda & Iacono, 1988; Remington & Clarke, 1983; Rotholz et al., 1989; Watters, Wheeler & Watters, 1981; Wherry & Edwards, 1983; Yoder & Layton, 1988) and intellectual disabilities (Barret & Sisson, 1987; Clarke, Remington & Light 1986; Clarke, Remington & Light 1988; Hodges & Schwelthelm, 1984; Iacono & Parsons, 1986; Sisson & Barret, 1984; Wells, 1981). Meticulous reviews of comparative studies involving unaided strategies have noted methodological concerns and threats to internal validity (Mirenda, 2003; Schlosser & Sigafoos, 2006), especially with early studies from 1970-1995 for which replication would be desirable. Nevertheless, a large number of studies provide greater support for the use of manual sign for individuals with developmental disabilities (ID, ASD, and impaired language and communication skills) relative to aided AAC strategies for learning receptive and expressive language skills (Schlosser & Sigafoos, 2006).

For example, Clarke, Remington and Light (1988) compared total communication training to sign-alone training using an adapted alternating treatments design with multiple probes, using independent sets of targets for each independent variable. Participants were four children with

severe ID (ages 5-10) and moderate to good scores on a vocal imitation pretest. Training consisted of 50 trials, 10 per target, and mastery required 10 consecutive correct manual signs over two sessions. Results indicated that all four participants learned all manual signs and did so significantly faster (approximately 60% faster) in the total communication condition (an average of 154 trials) compared to the sign-alone condition (an average of 248 trials). Two learners who improved their expressive speech showed increased vocalizations following total communication. Unfortunately, this study lacked intervention integrity.

Another study by Clarke, Remington, and Light (1986) used an adapted alternating treatment design to compare the acquisition of receptively known and unknown targets (five each) for three children with severe intellectual disabilities (ages 6-11) and moderate scores on a verbal imitation test. Daily training consisted of 50 trials, 10 per target, and mastery required 10 consecutive correct manual signs over two sessions. All three participants reached criteria significantly faster with receptively known targets (average of 560 trials) compared to receptively unknown targets (average of 1,023 trials). The participant with the highest vocal imitation score at pretest showed increased vocalizations both with known and unknown words. The major limitation of this study was the lack of intervention integrity data.

A limitation was reported when considering the use of manual sign training as acquisition may be inhibited if individuals lack prerequisite fine motor skills, cognitive skills, receptive language, social skills, and vocal language.

More recent evidence has been accumulated with empirical studies using manual sign training over the past 20 years for children with ASD (Carbone, Sweeney-Kerwin, Attanasio & Kasper, 2010; Seal & Bonvillian, 1997; Sigafoos & Meikle, 1995), children with severe intellectual disabilities (Dalrymple & Feldman, 1992; Duker, Kraaykam & Visser, 1994; Goodman & Remington, 1993; Hurd, 1996; Miller, Collins & Hemmeter, 2002; Remington & Clarke, 1993a, 1993b; Rudd, Grove, & Pring, 2007), and adults with severe ID and some with hearing impairments (Conaghan, Singh, Moe, Landrum & Ellis, 1992; Sundberg & Sundberg, 1990; Wraikat, Sundberg & Michael, 1991). The overall effectiveness of unaided ACC strategies for increasing communication skills has been substantiated by numerous reviews and meta-analyses

(Goldstein, 2002; Mirenda, 2003; Schlosser & Lee, 2000; Schlosser & Sigafoos, 2006) although there are a few studies that present sound methodology and reliable findings.

Summary of research findings regarding ACC strategies.

Reviews of AAC strategies (Goldstein, 2002; Schlosser & Lee, 2000; Schlosser & Sigafoos, 2006) acknowledge the current evidence support the use of manual sign instruction. A longer span of support for sign instruction has also been documented with sign as a major component in intervention packages under the category of unaided ACC strategies, especially when verbal feedback is paired within a total communication context (Goldstein, 2002; Mirenda, 2003) and when teaching a requesting function (Goldstein, 2002; Schlosser & Sigafoos, 2006).

Identifying an Optimal AAC Modality

While there is empirical support for the use of each of these popular AAC strategies (PECS or picture exchange and manual sign training) alone, there is little research to evaluate the relative effectiveness of different AAC options (Ganz et al., 2012; Schlosser & Sigafoos, 2006) or school-based instructional interventions teaching communication to individuals with ASD (Machalicek et al., 2008). Within this literature, much of the attention has focused on assessing variations in instructional variables (specific vs. non-specific reinforcement, known vs. unknown targets, total communication vs. sign only, etc.). Furthermore, the comparison research is diluted by the diversity of methods (PECS, total communication, various prompt strategies, milieu teaching, discrete trials, incidental teaching) employed on specific modes of communication (e.g., pictures and signs/gestures).

More recently, additional research on the PECS has questioned whether all components of the PECS are essential and whether modifications to methodology would produce equivalent effects (Ganz et al., 2008). Gregory et al. (2009) compared the effects of manual signing and exchange-based communication (EBC) on six children/adolescents with ASD and ID and reported faster acquisition with EBC. Other studies report generalized learning across PECS phases prior to direct instruction, suggesting that each specific phase may not need to be taught separately or sequentially (Angermeier, Schlosser, Luiselli, Harrington, & Carter, 2008). Studies have deviated from the PECS protocol and modified materials to address specific needs for

children (Ali, MacFarland, & Umbreit, 2011) and a therapist (Charlop, Malmberg, & Berquist, 2008) with visual impairments, suggesting deviations from protocol can produce effective results. Altogether, research continues to evaluate a diverse methodology to teach requesting skills and no specific procedure has been shown to be more effective than others.

Research studies that directly compare differential effects of various communication modes (i.e., pictures and manual signs), rather than comparing different modes that subsequently employ different methodologies, are wrought with problems and their results have been mixed. No specific and reliable recommendations are available for practitioners who are attempting to identify a particular mode of communication for their students. Presented with the choice of which communication strategy to teach, practitioners have only personal preferences and the subjective opinions of others.

A prolonged debate among practitioners has ensued without clear guidelines in the literature as to which of these two strategies is better. The earliest study to compare topography-based (TB) and selection-based (SB) systems (Hodges & Schwelthelm, 1984) involved 52 children with ID residing in an institution. However, advantages for manual sign over two selection-based systems was offset by differences in dependent variables in which mands were taught solely in the manual sign intervention. Another study (Rotholz et al., 1989) comparing aided and unaided strategies looked at the effectiveness of manual signing and a communication book on the mands of two older adolescents with ASD (ages 17 and 18). Results suggested that both individuals exhibited more requests and successful communication exchanges using communication books, although several threats to internal validity prevented a fair comparison between independent variables or the establishment of any functional relationship with mands (history of manual sign vocabularies, no baseline condition, order effects, and variation in prompting).

Two additional studies comparing SB and TB systems in adults with ID (Sundberg & Sundberg, 1990; Wraikat et al., 1991) lacked an adequate experimental design to evaluate a functional relationship to provide conclusive findings for one intervention over the other.

Furthermore, these studies did not involve children, participants possessed varying levels of vocal or verbal behavior prior to intervention, and outcomes did not specifically target mands/requests.

More recently, Vignes (2007) conducted a replication of the Sundberg and Sundberg (1990) study, comparing TB and SB systems with three typically developing children and three individuals with ASD (two adolescents, one adult) with respectively different levels of cognitive functioning, verbal behavior, and vocal behavior. Results showed that two individuals with ASD required fewer trials to criterion with the SB system, while the third did not reach criterion in either system. This finding, although possessing similar limitations regarding design and procedural integrity, contradicts Sundberg and Sundberg (1990) and supports growing evidence that individual differences may be more a result of participant characteristics than the intervention itself, specifically suggesting that individuals with weak verbal repertoires may be poor responders overall and most likely to respond to SB systems.

More recently, a handful of studies have been conducted comparing manual sign training and the PECS on expressive manding/requesting skills and vocalizations in children with PDD (Adkins & Axelrod, 2001), ASD (Anderson, 2001; Tincani, 2004), and adults with ID (Chambers & Rehfeldt, 2003). Adkins and Axelrod (2001) compared manual sign and the PECS for a child with PDD and AD/HD using an alternating treatment design. Results suggested faster acquisition and preference to request during generalization with the PECS. However, concerns about participant characteristics, item selection, lack of interrater reliability, incomplete description of procedures (the PECS appears to only include Phase I), and history effects warrant caution in drawing conclusions from this study.

The most rigorous and complete comparison study to date is Anderson's dissertation study (2001). Anderson used an adapted alternating treatments and multiple-probe design to compare the effect of manual sign and the PECS with six young children with ASD. Results indicated all participants were "responders" in both manual sign and the PECS interventions, with the exception of one student in the manual sign intervention. This demonstrated success for both ACC strategies with relatively young children (1-11 to 4-11) and mental age equivalents (15-19 months). The PECS was associated with success in a broader range of children, higher rate of

acquisition, and generalization to new items. Manual sign training was associated with higher levels of spontaneous initiation, eye contact, and vocalization at post-intervention. Anderson concluded that the results provided support for the use of either strategy, with additional benefits for the PECS in terms of efficiency and generalization. There are some concerns regarding the choice to teach single targets to mastery in each intervention and the disproportionate amount of time spent on particular items in the manual sign intervention that were eventually dropped from the study. Other key limitations of this study were that it was conducted in a clinical setting by the primary investigator and 12 graduate students, allowing for two sessions of each intervention daily. The setting and effort invested would not readily transfer to an educational setting that had more limited resources. A critical contribution to the research would be to replicate this study in a public school setting with teachers and paraprofessionals.

In a similar investigation, Tincani (2004) compared manual sign training and the PECS for two children with ASD and impairments in functional communication skills. This study was conducted in the student's classroom with the primary investigator and a second trainer. The investigation directly compared the PECS to manual sign and did not attempt to equate methodological components of the interventions. The author interpreted the data to show mixed results regarding acquisition of requests and more greater vocalizations with manual sign items was present until a time delay was used with the PECS to elicit similar levels of vocalization for one of the participants. Interesting findings included a relationship between prerequisite fine motor imitation skills and performance in manual sign training, and the observation of the possible effectiveness of using physical prompts rather than models when prompt dependence was observed with manual sign training. The greatest limitation of the study was an inadequate comparison of independent variables with different learner requirements.

Chambers and Rehfeldt (2003) used an alternating treatments design with baseline and generalization phases to compare manual sign training to the PECS with four adults (ages 19-40) with severe/profound ID in an adult training facility. This study provided additional support for the effectiveness of the PECS and partial support for the effectiveness of manual sign (two of four participants learned manual sign for all four targets). Generalization (spontaneous use) was

better with the PECS for two of three participants. However, the potential for carryover effects was a flaw in the design as the same targets were taught in both interventions.

In summary, over the past 20 years, only four research studies (Adkins & Axelrod, 2001; Anderson, 2001; Chambers & Rehfeldt, 2003; Gregory et al., 2009) have attempted to compare the differential effects of a single methodology or intervention on two different communication modes. Of these studies, only one (Adkins & Axelrod, 2001) evaluated the interventions in a school setting with the investigator alone conducting the interventions.

Summary of the Problem

While the importance of communication instruction for students with ASD and ID is clear, the research literature has provided little direction for practitioners who are attempting to select a particular mode of communication for their students. A number of theories and strategies have been offered (Carr & Durand, 1985; Koegel, O'Dell & Koegel, 1987; Koegel & Koegel, 2006; Bondy & Frost, 2002; Simpson, de Boer-Ott, Griswold, Myles, Byrd, Ganz et al., 2005; Simpson, 2005; Landa, 2007). However, empirical research has shown mixed results for specific AAC strategies for students with ASD and ID (Mirenda, 2003; Schlosser & Blischak, 2001; Schlosser & Lee, 2000; Tincani & Devis, 2011). For teachers who are attempting to identify an optimal communication strategy for their students, existing evidence is suggestive, but not definitive, regarding the relative effectiveness of manual sign training and the PECS (Ganz et al., 2012; Goldstein, 2002; Schlosser & Sigafoos, 2006; Tien, 2008; Tincani, 2004). Although results suggest the PECS strategy may apply to a broader range of individuals in terms of mand/request acquisition, manual sign may better facilitate vocal acquisition (Anderson, 2001; Chambers & Rehfeldt, 2003; Tincani, 2004). Several studies suggest that manual sign training may be a better choice for students who possess fine motor imitation skills (Anderson, 2001; Tincani, 2004), although evidence indicates that increased vocalizations are also mediated by pre-existing vocal imitation skills (Anderson, 2001; Tincani, 2004). Two other studies indicated the PECS may be a better choice for students lacking adequate fine motor skills or possessing moderate/severe impairments in cognitive ability and language (Seal & Bonvillian, 1997; Tincani, 2004). Unfortunately, the prescriptive use of any particular communication strategy based on individual

characteristics is not supported by research findings. Therefore, teachers who have the responsibility of choosing a particular communication strategy for their students have no clear evidence on which to base their decisions (Goldstein, 2002; Landa, 2007; Schlosser & Sigafoos, 2006; Tincani, 2004). Ultimately, they are left with the process of trial-and-error in choosing a communication strategy.

Aside from the limited quantity of research studies and their mixed results, additional inherent challenges exist in this comparative research. First, the PECS is a published curriculum with a strict protocol requiring multiple days of training, while manual sign training is not represented by a singular method or protocol. Second, these two strategies do not teach the same set of skills and therefore possess differences in procedures/methods, modality, and requirements of the instructor and learner. Third, efforts to control for key differences between the two strategies have varied across investigations and subsequently have led to comparisons of different versions of one or both independent variables. A fundamental question embedded in these previous comparative studies is which modality itself (i.e., pictures or manual signs) better facilitates the acquisition of communication that cannot be potentially attributed to variations in prompt procedures, performance criteria, or specific skills taught. Although more recent efforts have been made to establish equity between interventions when comparing TB and SB (Vignes, 2007) or manual sign to the PECS (Adkins & Axelrod, 2001; Anderson, 2001; Chambers & Rehfeldt, 2003), investigations have not been able to isolate the unique interaction between learners and the use of pictures or gestures to develop a basic communication repertoire. Further research is needed to more clearly identify whether one modality is better in terms of efficiency and various student outcomes. To date, this question has been blurred by various procedural details unique to the strategies used in addition to the modalities each strategy employs. No available studies have conducted a basic comparison of the effects of the two prominent communication modalities, pictures and manual signs, for children with autism and ID within the school setting with the existing natural resources.

Purpose of the Present Study

Many individuals with ASD and ID struggle to achieve effective communication skills throughout their educational career and into adulthood. While there is a wealth of research on how to teach language, there is little guidance regarding the decision-making process for selecting the optimal communication modality for any particular student. Therefore, the main purpose of this study was to provide a method for teachers in public education settings to identify an optimal modality for students with ASD and/or ID who have limited or no functional communication by comparing the relative effectiveness of using pictures and manual signs to request highly preferred items. More specifically, the following research questions were addressed:

Research Question 1a: Using a single communication instruction method, which mode (pictures vs. manual signs) resulted in more efficient learning as measured by the percentage of independent requests per session? Secondary analysis looked at the number of trials to mastery for independent requests.

Existing research comparing outcomes with the PECS or EBC training compared to manual sign training suggests that the PECS/EBC results in faster acquisition rates when participants are not expected to discriminate (Adkins & Axelrod, 2001), are taught single items to mastery before moving on to other items (Anderson, 2001; Gregory et al., 2009), are not expected to discriminate and have low fine motor imitation skills (Tincani, 2004), and for adults with ID (Chambers & Rehfeldt, 2003). Due to the individual nature of students with ASD and ID, overall advantages in mand acquisition rates and frequency for specific AAC strategies across students is not conclusive. **Therefore, it was hypothesized there would be no differences in the efficiency of learning between picture-based training and manual sign across subjects but that individual differences would be evident within subjects.**

Research Question 1b: Using a single communication instruction method, which mode (pictures vs. manual signs) resulted in more efficient learning as measured by the number of trials and sessions to mastery of discriminated requests?

Existing research comparing outcomes with the PECS training compared to manual sign training suggests that the PECS results in faster acquisition rates. However, these studies only

taught mastery without discrimination (Adkins & Axelrod, 2001; Tincani, 2004), taught single items to mastery before moving on to other items (Anderson, 2001; Gregory et al., 2009), or taught adults with ID (Chambers & Rehfeldt, 2003). Due to the individual nature of students with ASD and ID, overall advantages in mand acquisition rates and frequency for specific AAC strategies across students is not conclusive. **Therefore, it was hypothesized there would be no differences in the efficiency of learning between picture-based training and manual sign across subjects but that individual differences would be evident within subjects.**

Research Question 2a: Using a single communication instruction method, which mode (pictures vs. manual signs) resulted in more effective learning as measured by number of items meeting mastery criteria for independence? Secondary analysis looked at the percent of nonoverlapping data between baseline and intervention and the average percent of independent requests for each intervention.

Research suggests that the PECS or EBC strategies may apply to a broader range of individuals in terms of mand/request acquisition (Adkins & Axelrod, 2001; Anderson, 2001; Chambers & Rehfeldt, 2003; Gregory et al., 2009) or more specifically to individuals with low motor imitation skills (Tincani, 2004). However, these studies are few in number and possess limitations in their design. Current research on the effectiveness of specific AAC strategies with students with ASD and ID is not conclusive. It can be argued that there are inherent advantages with picture-based strategies as individuals perform the same motor behavior for all items whereas manual sign strategies require the individual to learn a new motor sequence for each new target. However, this contrast should be minimal when motivation is controlled for and learners are taught the same skills across modes of communication. **Therefore, it was hypothesized there would be no differences in the effectiveness of learning between picture-based training and manual sign across subjects but that individual differences would be evident within subjects.**

Research Question 2b: Using a single communication instruction method, which mode (pictures vs. manual signs) resulted in more effective learning as measured by number of training items meeting mastery criteria for discrimination? Secondary analysis

looked at the average percent of discriminated requests across sessions for each intervention.

Following the same evidence from research hypothesis 2a, **it was hypothesized there would be no differences in the effectiveness of learning between picture-based training and manual sign across subjects but that individual differences will be evident within subjects.**

Research Question 3: Using a single communication instruction method, which mode (pictures vs. manual signs) resulted in more vocalizations as measured by percent of trials in which vocalizations occur?

Evidence to date has shown a slight advantage in vocalizations for items taught using manual sign training as compared with items taught using the PECS for children and adults with autism and ID (Anderson, 2001; Tincani, 2004; Chambers & Rehfeldt, 2003). Again, these studies are few in number and possess limitations in their design. Some researchers contend that manual signs more closely resemble vocal language (one-to-one correspondence between each manual sign or word and its referent) and should therefore provide better stimulus control and result in better vocal language production (Michael, 1985; Potter & Brown, 1997; Sundberg & Partington, 1998). This study sought to address this issue more definitively by conducting a basic comparison between the use of pictures and manual signs while eliminating inherent differences in training methods and procedures. **It was hypothesized that communication with manual signs would result in higher vocalization acquisition rates compared to pictures.**

Research question 4: Using a single communication instruction method, which mode (pictures vs. manual signs) resulted in more generalization as measured by the frequency of probes in which spontaneous mands, communication with novel people, and communication in novel settings are observed?

Evidence to date suggests potential advantages with the PECS over manual sign for spontaneous use of items (Adkins & Axelrod, 2001; Chambers & Rehfeldt, 2003) and generalization sessions (Adkins & Axelrod, 2001; Chambers & Rehfeldt, 2003), although these studies have critical design flaws. Mixed results were reported for spontaneous use of items (Anderson, 2001) and generalization to novel persons/settings (Anderson, 2001; Tincani, 2004) based on individual responsiveness. **Therefore, it was hypothesized there would be no differences in the effectiveness of learning between picture-based training and manual sign across subjects but that individual differences would be evident within subjects.**

CHAPTER 2

LITERATURE REVIEW

This chapter will review relevant literature from several fields including augmentative and alternative communication (AAC), applied behavior analysis (ABA), and naturalistic language procedures. In the first section, research studies evaluating use of AAC strategies in the instruction of initial communication skills for individuals with ASD and/or ID were reviewed. Analysis of AAC strategies was delineated by their modality as either picture training (i.e., aided communication and stimulus-selection-based communication) or manual sign training (i.e., unaided communication and topography-based communication). Next, evidence from contemporary approaches incorporating ABA and naturalistic language procedures was reviewed to establish “best practices” shared across disciplines. The review will conclude with a focus on contemporary comparison studies and their strengths and limitations. Throughout the chapter, specific attention was given to the common methods shared across disciplines, in an effort to establish a concise methodology from this large compilation of research findings.

Established Research for Unaided and Aided AAC Strategies

Common threads supported across disciplines were identified in the context of this research. Focus is on categorizing AAC strategies as either unaided or aided.

Unaided AAC Research

The two major unaided AAC strategies are speech communication training and variations of manual sign training. When these are combined, they are considered “simultaneous communication training” or total communication training.

Manual sign training. Over the past 40 years, a range of empirical support has been documented for the use of sign language as a viable communication modality. Early research found support for the use of manual sign training in teaching expressive and receptive language skills (Bonvillian & Nelson, 1976; Brady & Smouse, 1978; Carr, Kologinsky & Leff-Simon, 1987; Hurd, 1996; Kouri, 1988; Layton & Baker, 1981; Miller & Miller, 1973; Mirenda & Iacono, 1988; Remington & Clarke, 1983; Rotholz & Berkowitz, 1989; Yoder & Layton, 1988). Empirical studies using manual sign training over the past 20 years have been conducted for children with severe

ID (Dalrymple & Feldman, 1992; Duker et al., 1994; Goodman & Remington, 1993; Hurd, 1996; Miller et al., 2002; Remington & Clarke, 1993a; Remington & Clarke, 1993b), children with ASD (Bonvillian et al., 1981; Seal & Bonvillian, 1997; Sigafos & Meikle, 1995), and adults with severe ID, and some with hearing impairments (Conaghan et al., 1992; Sundberg & Sundberg, 1990; Wraikat, Sundberg & Michael, 1991). Again, various studies possess threats to internal validity but, in combination with empirically sound studies, can offer support and direction for future replication studies.

Goodman and Remington (1993) compared the effects of specific (requests) and non-specific (labels) reinforcement in the acquisition of manual signs in four children with severe ID (ages 4-7). An adapted alternating treatment design was used to compare trials to criterion. All four participants effectively learned the manual signs in both conditions but greater efficiency was found in the specific reinforcement condition for three of the four participants. The study's design provides confidence in these findings despite the lack of intervention integrity data. Implications of this finding support the contention that specific reinforcement, present in manding trials and not with other verbal operants (e.g., tacts/labels), results in increased learner motivation and efficiency (Bondy, Tincani, & Frost, 2004; Michael, 1985; Sundberg, 1993; Schlosser & Sigafos, 2006). This finding has important ramifications for target selection in terms of verbal operants. Mands, which are specifically reinforced by providing the learner with the object requested, would be suggested as the initial instructional targets. In comparison, other operants and tasks, such as tacts or expressive identification (learner labels a picture or touches the picture of dog), are consequted by non-specific reinforcement (verbal praise for correct responses, delivery of an edible, etc.). The majority of research over the past decade has validated this approach in its focus on teaching participants to request preferred items (Adkins & Axelrod, 2001; Anderson, 2001; Tincani, 2004; Charlop-Christy et al., 2002; Chambers & Rehfeldt, 2003; Ganz & Simpson, 2004).

Schlosser and Sigafos (2006) reviewed comparative studies examining a variety of procedures that included extensive sign instruction (over-instruction) and mediated sign instruction (receptive pre-instruction). Conclusions were drawn for equal effectiveness but

greater efficiency in expressive signing for extensive sign instruction compared to mediated sign instruction (Remington & Clarke, 1993a; Remington & Clarke, 1993b). Dalrymple and Feldman (1992) found that, when directed rehearsal (correction procedure to practice correct formation) was added to sequential prompting or graduated guidance, responses showed increased accuracy, reduced speed, and enhanced generalization across trainers, objects, and settings. This would suggest that providing physical prompts with repetition may enhance learning solely from sequential prompts or graduated guidance.

Simultaneous communication training. Bonvillian et al. (1981) reviewed 20 empirical studies that included roughly 100 participants with ASD to evaluate the effects of manual sign training alone or in conjunction with speech communication training (Simultaneous Communication). Minimal inclusion criteria included ages 3-23 with ASD and various degrees of communication impairment. Results reported sign acquisition in various degrees with vocabularies ranges of 5-350 signs training for low-functioning children with ASD. Limited effects were found regarding spontaneous use of signs or complex utterances. A pattern of higher sign vocabularies and acquisition of spoken language was reported for children categorized as high vocal-verbal imitators.

Yoder and Layton (1988) assessed four different language training interventions on the speech of 60 children with ASD and minimal vocal language. They replicated the findings of Bonvillian et al. (1981) for better sign acquisition for high vocal-verbal imitators. Yoder and Layton also found that speech-alone training performed as well as the other trainings and better than sign-alone training.

Clarke et al. (1988) compared total communication training to sign-alone training using an adapted alternating treatments design with multiple probes using independent sets of targets for each independent variable. Participants were four children with severe ID (ages 5-10) and moderate to good scores on a vocal imitation pretest. Training consisted of 50 trials, 10 per target, and mastery required 10 consecutive correct manual signs over two sessions. Results indicated that all four participants learned all manual signs and did so significantly faster (approximately 60% faster) in the total communication intervention (an average of 154 trials)

compared to the sign-alone intervention (an average of 248 trials). Two learners that improved their expressive speech showed increased vocalization following total communication. This study applied a sound methodology and was primarily limited by the absence of intervention integrity.

Clarke et al. (1986) used an adapted alternating treatment design to compare the acquisition of receptively known and unknown targets (five each) for three children with severe ID (ages 6-11) and moderate scores on a verbal imitation test. Daily training consisted of 50 trials, 10 per target, and mastery required 10 consecutive correct manual signs over two sessions. All three participants reached criteria significantly faster with receptively known targets (average of 560 trials) compared to receptively unknown targets (average of 1,023 trials). The participant with the highest vocal imitation score at pretest showed increased vocalizations both with known and unknown words. The major limitation of this study was the lack of intervention integrity data. In addition, when comparing SC to manual sign alone, differences were not evident when targets were receptively unknown (Remington & Clarke, 1983; Clark et al., 1988). Consistent with Bonvillian et al. (1981), Clarke et al. (1988) asserted that SC did not evidence disadvantages in comparison to manual sign alone and should be considered as the better choice.

These studies suggest that providing verbal feedback by labeling the training items provides a richer context for the learner, a procedure that has been incorporated in more recent investigations (Adkins & Axelrod, 2001; Anderson, 2001; Tincani, 2004; Charlop-Christy et al., 2002; Chambers & Rehfeldt, 2003; Ganz & Simpson, 2004) and as part of the PECS protocol (Bondy et al., 2004). In addition, a recent review of comparative studies by Schlosser and Sigafoos (2006) concluded that reinforcement in addition to direct rehearsal (repeating the correct response) was found to be more efficient in expressive sign acquisition (Linton, & Singh, 1984) and generalization across novel phrases, settings, and instructors (Conaghan et al., 1992). Altogether, whether categorized as directed rehearsal, simultaneous communication, or total communication, providing immediate verbal feedback by labeling the requested item is a proven strategy.

Strengths and limitations of unaided AAC research. Mirenda (2003) summarized existing research, although lacking adequate internal validity for conclusive findings, to support

total communication (sign plus vocal) for students with adequate fine motor skills in the areas of receptive and expressive labeling. Based on a meticulous review of comparative studies involving unaided strategies, Schlosser and Sigafoos (2006) extend a number of findings with sound empirical support, although replication would be desirable. First, manual signing has benefitted from a large number of studies to support its use with individuals with developmental disabilities (ID, ASD, and impaired language and communication skills) in learning receptive and expressive language skills. Second, the combination of manual signing and simultaneous communication training shows advantages in efficiency, accuracy and generalization compared to either modality alone. Some of the additional procedures recommended included using specific reinforcement (starting with the mand) and targeting receptively known words first. Relative to aided AAC strategies, unaided strategies appear to have more support in the literature. However, many of the early studies from 1970-1995 contain methodological concerns and threats to internal validity (Mirenda, 2003; Schlosser & Sigafoos, 2006). Furthermore, in a brief reported by Schwartz and Nye (2006) on the evidence basis for sign language instruction for children with ASD, only 8 studies met criteria for inclusion. Seven single subject design studies suggested an overall moderate intervention effect (PND=80%) for teaching communication skills to children with autism using signs only or a total communication strategy. Limitations of these studies included lack of data on intervention integrity, generalization, and details of intervention procedures. Schwartz and Nye cautioned practitioners that single subject research offers limited support for the use of sign language for children with autism. Compared to aided communication strategies, practical advantages credited to unaided strategies are thought to include flexibility, universal access, and a sense of ownership. Conversely, disadvantages include limited application to “untrained” listeners who may not understand manual signs and limited potential for generalization to new stimuli without direct instruction (learning new signs rather than having new pictures available to exchange).

Aided AAC Research

Major strategies in this category include picture-based systems (picture-point cards, PECS), vocal output devices (Big Mac switches, keyboards with output), visually directed systems (using eye gaze or head movements), and combinations. Focus within the literature has primarily been on picture-based systems.

Picture-based systems. Several studies have shown support for the use of picture-based systems for children (Hamilton & Snell, 1993; Sigafoos, 1998; Stiebel, 1999) and adults (Reichle & Brown, 1986; Rotholz et al., 1989; Vaughn & Horner, 1995). For example, Hamilton and Snell (1993) used a changing criterion design within a multiple probe design across settings to assess the effects of milieu training methods to teach the fluent use of a communication book for a 15-year-old boy with ASD and severe ID. Instruction used a system of increasing prompts starting with an expectant look, adding a verbal prompt of “what do you want?”, adding a verbal prompt of “show me ____ in your book”, and ending by adding a model of the response by pointing to the item). Results showed increased use of the communication book across four different school and home environments. After an average of 12 weeks of training in each environment, the participant met criteria for using his book during 75% of all opportunities. These skills were maintained after 1 year, with no problem behaviors 2 years after intervention. Limitations of the study included the potential that the intervention changed the performance of an existing skill rather than teaching the initial skills of requesting, as suggested by the pre-existence of the communication book prior to the study and slight increases in the other three baseline sessions upon intervention in the first setting. One major limitation of picture-point systems is that an adult’s joint attention is required at the moment the request is made, which creates logistical challenges and persistence of the learner when attention is not available and pointing responses are not received.

More recently, research is emerging on picture systems that use an exchange or manipulation as part of the request form but do not adhere to the PECS protocol and phase system. This category is called Exchange-Based Communication (EBC). One recent study assessed the correspondence between requesting and selecting following the acquisition of

several exchange-based requesting responses for two adolescents with ID or ASD within a private school setting (Sigafoos, Ganz, O'Reilly, Lancioni & Schlosser, 2007). Both participants learned to request using EBC but one student lacked correspondence and required specific correspondence training.

The PECS. The use of picture-based communication systems has become dominated by the PECS strategies initially developed by Bondy and Frost (1994). A number of early investigations reported positive outcomes using the PECS (Bondy & Frost, 1993; Schwartz, Garfinkle & Bauer, 1998) but more recent and rigorous investigations have established PECS as a promising AAC strategy for teaching requesting/manding skills to children with ASD (Anderson, 2001; Charlop-Christy et al., 2002; Ganz et al., 2010; Ganz et al., 2009; Ganz & Simpson, 2004; Ganz et al., 2008; Howlin et al., 2007; Kravits et al., 2002; Tincani, 2004; Tincani et al., 2006; Yoder & Stone, 2006a, 2006b) or adults with severe/profound disabilities (Chambers & Rehfeldt, 2003). Furthermore, PECS has received increasing attention through numerous reviews and meta-analyses documenting general effectiveness for the PECS (Ganz et al., 2012; Hart & Banda, 2010; Preston and Carter, 2009; Tincani & Devis (2011)).

Charlop-Christy et al. (2002) provided the first empirical study to support the use of the PECS by measuring mastery criteria in terms of trials and time to mastery. Three boys (ages 4-12) were taught to use the PECS system with bi-weekly training in an isolated room lasting 15 minutes per session. Participants possessed limited vocal imitation skills and two dimensional discrimination skills. All three participants, on average, acquired the PECS Phases I-VI in 170 minutes (range of 165-176) and 246 trials (range of 224-276), demonstrated increases in social communicative behavior and initiations/requests during free play sessions. Decreases in problem behaviors were reported for two participants.

Ganz et al. (2008) used a multiple baseline design across three preschool participants with ASD. Adherence to the PECS protocol (Frost & Bondy, 2002) was followed in this study. Results showed one participant mastered the first four phases of PECS, one required lengthy training to master phases 3-4, and a third participant failed to master the PECS according to protocol. No substantial increases in expressive speech were evident as a result of the PECS

training. These results were considered to be a departure from established research where the inability to master the PECS is rarely reported and some vocalized responding is typically reported. This may partly be explained by the relatively young age of the participants and may also reflect the potential bias of publishing research with better outcomes.

Dogoe, Banda, and Lock (2010) assessed the acquisition and generalization of the PECS for three young children with ASD using a multiple baseline across participants design. Training was conducted by the first author within a university-based center and generalization was assessed in community and home settings. Results showed that all three participants mastered the PECS through Phase III in 157-313 trials, with criterion of 80% or better over three consecutive sessions. All participants were able to generalize requests to new persons and settings. Two of three participants were able to generalize to new requests that were not directly taught. This finding appears to be the first example of generalization across stimulus classes.

Tien (2008) reviewed 13 studies with 125 participants focusing primarily on using PECS to teach functional communication skills to individuals with ASD. All of the studies documented the effective use of PECS along with increases in overall communication (62%), spontaneous language/speech/imitation (46%), initiation of communication (31%), and in mean length of utterance (23%). Overall, results of the studies reviewed provided evidence for the effectiveness of PECS.

Preston and Carter (2009) conducted a comprehensive review of the empirical literature specific to the implementation of the PECS protocol calculating both PND and PEM (percentage of data points exceeding the median; Ma, 2006). A total of 456 participants in 27 studies (pre-experimental, single-subject, and group designs). Only five studies presented data on maintenance with mixed and dubious results, five studies provided procedural reliability data, 15 studies included primarily positive data on generalization although this term was quite varied in its use, overall efficacy primarily relied on data from single subject studies (PND = 78.5%; PEM = 89.1%) and provided "the preliminary conclusion that PECS may be an effective intervention" (pg. 1481). No differences in PND were found for age, gender, setting, maintenance, generalization,

or research design. Differences between single subject studies favored picture exchange over other ineffective outcomes (speech, social, behavioral) and lower PND for individuals with ASD.

Hart and Banda (2010) conducted a meta-analysis of single subject studies using the PECS for individuals with ID. Results from 13 studies and 36 participants indicated that PECS was highly effective (54%) or moderately effective (29%) and increased communication across age, disability, and communication levels. PECS resulted in various forms of generalization (54%), increased speech in 4 of 10 participants, and equivalent effects when compared to VOCA (n = 9) and somewhat better effects when compared to sign (n = 6).

Tincani and Devis (2011) conducted a meta-analysis on single-participant studies using the PECS protocol to support the few recent group studies in which favorable and mixed outcomes were reported using PECS and to conduct component analyses of critical variables. Results indicated an overall PND of 80.1 for the 16 studies and 44 participants analyzed, concluding PECS to be a moderately effective intervention regardless of participant diagnoses, age, gender, highest phase of PECS mastered, or setting.

Ganz et al. (2012) conducted a meta-analysis of single case research on aided communication for individuals with ASD using the Improvement Rate Difference (IRD: Parker, Vannest, and Brown, 2009) and also PND as metrics for evaluation. Results indicated overall strong effects for aided AAC strategies (IRD = 0.99; PND median of 76%). Specifically, large effects (IRD = .99) for both PECS and SGD (speech generating devices) were indicated with significantly lower and moderate effects for other picture-based AAC (IRD = 0.61). Ganz et al. (2012) noted variation in IRD measures across studies, especially regarding picture-based strategies where the two lowest effect sizes involved single participants with both ASD and developmental delays. Interestingly, studies were also coded as child-led (child declares motivation and initiates for stimuli controlled by adult), natural (child-led and access not strictly controlled by adult), or teacher-led (teacher initiated or led mostly contrived situations). PECS was mostly classified as child-led while SGD and other picture-based systems were equally coded as natural and teacher-led. This level of analysis would provide an anecdote of no specific differences between any of the three experimental situations. Individual studies with IRD ranges

above 0.50 indicated that 5 studies (4 PECS and picture-based) were child-led, 3 studies were natural (2 SGD and 1 picture-based), and 2 were teacher-led (1 SGD and 1 picture-based). Anecdotally, this also provides little difference between AAC strategies regarding the studies with the highest effect sizes.

Strengths and limitations of aided AAC research. Research investigations with good internal validity have demonstrated that the PECS is a valid strategy that can be successfully taught to individuals with ASD and ID. Additional research is needed regarding generalization and maintenance, and the relationship of picturing training with vocalizations. Inherent advantages of aided communication strategies include easy application to “untrained” listeners and the potential for generalization to new stimuli (learning new pictures without being directly instructed). Practical disadvantages include the necessity of remembering and carrying around communication books and fluency in finding and exchanging pictures.

Framing the Debate

Communication theory has framed comparisons between numerous AAC strategies based on major distinguishing factors related to what the learner and speaker are required to do and specific learner outcomes. One distinction that has been argued is whether the communication strategy requires the individual's response to be similar across communication targets (e.g., PECS) or varied (e.g., manual signing, vocal language) (Michaels, 1985; Sundberg & Sundberg, 1990). Michaels (1985) asserted that topography-based strategies (TB) require varied learner responses following discrimination in selecting the appropriate sequence of actions to create target-specific topographies (i.e., one-to-one correspondence between the action/response and the target symbolized). Two common examples would be using different manual signs for different targets/words or making different vocal sounds for different words. In contrast, stimulus selection-based strategies (SB) are associated with a more standard learner response following a prerequisite discrimination among various stimuli, which are often presented visually (Michaels, 1985). Examples include selecting a picture and giving it to the communicative partner, a response/action that is identical regardless of what picture is selected. A second point of distinction that has been made more recently is based on whether the AAC

strategy requires assistance (i.e., aided communication such as picture-based systems) or can be performed by the individual without equipment or devices (i.e., unaided communication such as manual signs) (Mirenda, 2003; Schlosser & Sigafoos, 2006). Over the past decade, discussions have evaluated AAC strategies according to this framework in an effort to identify specific components that optimize individual outcomes and to identify a “best” strategy for use with individuals with ASD and/or ID. Unfortunately, empirical investigations and other literature reviews over the past 40 years lack definitive results and more recent efforts share in the challenge of electing a “best strategy.”

Selection-Based vs. Topography-Based Communication

One paradigm for comparing various communication modalities is focusing on the response requirement for the individual. Historically, topography-based (TB) verbal behavior was defined as an increased strength of a distinguishable response topography given some specific controlling variable (e.g., saying or signing “cookie” when you want a cookie requires a different sound or manual sign than saying or signing “hot dog” when you want a hot dog) (Michael, 1985). In contrast, stimulus selection-based (SB) verbal behavior involved an increased strength of a generalized response that does not have a distinguishable topography across stimuli (i.e., there is no topographical difference between exchanging a picture icon of a cookie or hotdog when hungry) (Michael, 1985).

With this distinction, manual sign training parallels spoken language as each manual sign is unique in topography and its correspondence to the object or referent, much like words, and should better facilitate discrimination among newly acquired vocabulary and acquisition of vocal language (Michael, 1985; Sundberg & Sundberg, 1990; Potter & Brown, 1997). Because SB strategies require a conditional discrimination and scanning repertoire (when hungry, the student cannot simply exhibit a manual sign for “hot dog” but must locate the communication book and retrieve the appropriate picture icon), stimulus control is theorized to be more difficult to establish (Michael, 1985; Sundberg & Sundberg, 1990; Potter & Brown, 1997).

One advantage of the PECS is that it does not require eye contact or prerequisite fine motor and vocal imitation skills (Tincani, 2004). Although a frequently cited disadvantage of SB

strategies (specifically, the PECS) is that they deviate more from conventional, spoken language, it is precisely this characteristic that is put forth as an advantage of the PECS and SB strategies. Because the learner need only acquire a small set of responses (selecting and exchanging picture icons) to communicate a potentially infinite number of targets, and the PECS has a lower requirement for prerequisite skills, it is argued that the PECS can be successful with individuals possessing a broader range of abilities and functioning levels (Tincani, 2004; Frost & Bondy, 2002). In considering the listener, advantages of using SB strategies are that the message is easily discernible (picture or vocal output) and can be directed toward most audiences. This is perhaps the biggest criticism of TB strategies like manual signing where few persons will understand a manual sign compared to a picture icon (Bondy & Frost, 1994).

Aided vs. Unaided Communication

The field of AAC can be viewed with another lens that differentiates between aided and unaided communication options. Unaided communication strategies do not require equipment or devices and rely solely on the body (e.g., sign, gestures). Aided communication strategies do require equipment or devices (pictures, symbols, PECS, V.O.C.A., etc.) and some sort of external support (maintaining equipment). Substantial and sustained debate has existed over the advantages of each category of AAC and which is best for individuals based on disability type, fine motor skills, visual skills, and a range of other characteristics. Several reviews of this literature have provided support for the general use of AAC strategies. Schlosser and Lee (2000) conducted a meta-analysis of 20 years of AAC research from 50 studies. Across all age groups and disabilities, unaided AAC approaches were significantly more effective regarding acquisition, but not regarding generalization or maintenance (Barrera et al., 1980; Barrera & Sulzer-Azaroff, 1983; Brady & Smouse, 1978; Yoder & Layton, 1988; Remington & Clarke, 1983). It could be argued that both strategies are dependent upon external presentation of each communication target (having a picture for “taco” or learning the manual sign for “taco”) and that generalization to novel targets are more difficult for unaided strategies (i.e., it is more likely that one would find a picture of a taco without assistance rather than identify/learn the manual sign for taco without assistance). However, less than 10% of studies involved students with ASD. A second limitation

of these research studies was that only one study directly compared aided and unaided communication techniques (Iacono, Mirenda & Beukelman, 1993). Therefore, although this research has support for the effectiveness of individual strategies, it cannot be used to inform the process of directly comparing different communication strategies with individual learners.

Mirenda (2003) summarized existing research as lacking adequate internal validity for conclusive findings but did comment on some preliminary trends in the research suggesting better support for using unaided communication (sign plus vocal) for students with adequate fine motor skills regarding the outcomes of receptive and expressive labeling. In contrast, aided communication strategies better addressed the more functional domain of manding/requesting. Unfortunately, these claims are limited and require replication by investigations with sound methodology. Unaided strategies arguably have the advantage in ease of maintenance, sense of ownership for the learner, and a low probability of being denied access to the communication strategy. However, aided strategies arguably can generalize to novel listeners (comprehension of pictures would be more likely than manual signs) and stimuli (likelihood of using “untaught” pictures greater than “untaught” manual signs), and provide a permanent prompt for the speaker. With the extensive use of such strategies in practice, the paucity of conclusive research in this area is a concern.

Millar et al. (2006) conducted a review using best evidence analysis to examine the impact of AAC intervention on speech production with 23 studies containing 67 participants with developmental disabilities (primarily ID or ASD). Because every study reviewed contained limitations in design or intervention integrity, results were limited to six, well-designed studies containing 17 participants as the “best evidence”. Of these studies, five used manual sign (unaided) and one used PECS. Modest gains in speech production were reported for 16 of 17 participants. Overall, there is a lack of well-designed studies to inform the impact of ACC interventions on speech production based on the quantity, quality, age, and diversity of instructional strategies incorporated within the AAC literature.

Contemporary ABA Approaches to Teaching Communication

An evaluation of communication based treatments for individuals with ASD noted that ABA continues to be a well-established treatment (Brunner & Seung, 2009). Landa (2007) outlined the key components of contemporary approaches incorporating ABA principles as those that emphasize the student's motivation to communicate (i.e., mands, topics and activities that are preferred and selected by the child), focus on literature and principles of behavior (ABA), facilitate spontaneous language, view the child as an active communicator, incorporate natural rewards and contingencies, embed instruction within natural environments, and focus on facilitating spontaneity and increasing the duration and frequency of opportunities to respond. Furthermore, Landa (2007) identified the application of these principles into various approaches that include Incidental Teaching (McGee, Morrier, & Daly, 1999), Natural Language Paradigm (Koegel et al., 1987), Pivotal Response Training (Koegel & Koegel, 2006), and the Picture Exchange Communication System (Bondy & Frost, 2003). In addition, parallel and somewhat overlapping efforts are apparent in the application of other strategies available to teaching early communication skills. Functional Communication Training was devised based on principles of applied behavioral analysis within a more specific scope relevant to behavior modification rather than teaching language and communication in a broad sense. A brief description is provided below for each approach, with an effort to highlight the common procedural elements for comparison to the AAC literature. In addition, based on a comprehensive effort undertaken by Simpson and colleagues to identify evidence-based practice for children of all ages with ASD (Simpson et al., 2005; Simpson, 2005), empirically based support was noted for each of these components.

Ostry et al. (2008) reviewed the literature using the communication competence paradigm, noting that communication should ultimately extend beyond asking for basic wants and needs. Consideration of Light's functional communication paradigm (2003) warrants additional outcomes that should include areas of developing social closeness, exchanging information, and fulfilling social etiquette requirements. Under this paradigm, the PECS research was limited in quantity and scope, with suggestions that additional communication components would be

needed to supplement PECS (e.g., asking questions, joint attention). More interestingly, only three comparison studies using PECS met criteria for inclusion in the Ostry et al.'s analysis (2008). Within the paradigm of functional communication competence theory, these limitations appear to be more imposing when looking at comparative literature between communication systems/modes.

Incidental Teaching

Incidental Teaching focuses on setting up aspects of the environment to entice students to engage in instruction, identifying instructional objectives (e.g., mand) to plan for, placing preferred items in sight but out of reach, responding to the child's motivation to obtain items by providing instruction (e.g., model the mand), eliciting additional responses from the child when motivated, and praising/rewarding the child (Hart & Risley, 1982). These strategies have been identified as promising practices with "efficacy and utility with ASD," but need more verification (Simpson et al., 2005; Simpson, 2005).

Milieu Teaching and Natural Language Paradigm

These strategies differ from other strategies focused on teacher choice, manual prompts, strict shaping, and edible reinforcement. Stimuli are chosen by the child, varied, age-appropriate, and found in the natural environment. The teacher and child both play with the stimulus item within the context of functional interactions. A loose shaping contingency is used so that attempts to respond verbally (except for self-stimulation) are also reinforced (Koegel et al., 1987). Research has specifically addressed Milieu teaching and its components (incidental teaching, mand model, and time delay) through several randomized group studies (Yoder & Stone, 2006a; Yoder & Stone, 2006b) that have advanced the level of evidence to one of empirically demonstrated efficacy (Brunner & Seung, 2009). Components of this methodology are considered best practice and often incorporated into strategies used in the field.

Pivotal Response Training

This approach focuses on a few “pivotal” skills that can be generalized and characterize skills that elicit responses from peers and foster educational/social gains (Koegel & Koegel, 2006). Examples of “pivotal” skills would include attending to key aspects of the task or instruction, and social, communication, and self-management skills. Procedures suggest starting with highly preferred tasks and using natural environments and reinforcement (Koegel & Koegel, 2006). Several studies have been conducted using PRT and have demonstrated gains in expressive language use, play behaviors, and social behavior (Sherer & Schreibman, 2005), and initiating and responding to bids of joint attention (Jones, Carr & Feely, 2006; Whalen & Schreibman, 2003). These strategies have been identified as scientifically based practices with “significant and convincing empirical efficacy and support” (Simpson et al., 2005; Simpson, 2005). More recently, this method has advanced to the level of demonstrating effectiveness for a specific subgroup of children with autism and has provided early evidence for the application of PRT to joint attention training (Brunner & Seung, 2009; Koegel, Matos-Fredeeen, Lang & Koegel, in press).

Functional Communication Training

This approach combines the functional assessment of behavior and language instruction to address communicative acts that both replace or substitute for problem behaviors and achieve the same function more efficiently than the original problem behavior. Replacement behaviors are chosen that match the student’s motivation and readily apply across natural environments (Carr & Durand, 1985). This approach is effective in reducing problem behavior and teaching basic communication, although evidence is limited regarding generalization and maintenance (Mancil, 2006; Olley, 1999). A more recent review (Brunner & Seung, 2009) noted that the majority of support for this approach is limited to single-subject studies.

Picture Exchange Communication System

This approach uses a picture modality while incorporating aspects of child motivation (i.e., start by teaching mands/requesting first), facilitating communication across natural settings and audiences, providing multiple opportunities to respond, and using empirically-based methods

within communication instruction (Bondy & Frost, 2002). These strategies have been identified as promising practices with “efficacy and utility with ASD” but need more verification (Simpson et al., 2005; Simpson, 2005).

Identifying an Optimal Modality

One of the most important decisions for clinicians and for the individuals receiving services to address communication needs is selecting a suitable modality for learning communication skills. This may be done through a systematic analysis of learner characteristics and environmental demands (Van der Meer et al., 2011). Decisions between aided and unaided AAC systems should consider the individual’s motor skills, visual perception of various graphic symbol presentations or displays, high or low tech systems, and other various characteristics. However, there are a limited number of school-based studies on teaching communication skills to individuals with ASD (Machalicek et al., 2008). Some limitations were reported when considering the use of manual sign training as acquisition may be inhibited if individuals lack prerequisite fine motor skills, cognitive skills, receptive language, social skills, and vocal language.

Recent efforts to determine preference based on individual “choice” (Van der Meer et al., 2011) were reviewed for seven studies (12 total participants) in which preferences for using AAC strategies (speech-generating devices or picture exchange) were assessed following intervention. Although definitive methods for determining individual preferences were not achieved, the potential for embedding opportunities for self-determination by assessing individual preferences for AAC options may provide another level of determining an optimal communication modality and system for individuals with ASD and ID.

There are a limited number of demonstrations in selecting/comparing communication modalities and AAC strategies such as the PECS or picture symbols, sign, and V.O.C.A. (Adkins & Axelrod, 2001; Anderson, 2001; Beck, Stoner, Bock & Parton, 2008; Bock et al., 2005, Chambers & Rehfeldt, 2003; Gregory et al., 2009; Rotholz et al., 1989; Tincani, 2004; Wraikat et al., 1991). Three studies directly compared manual sign and the PECS (Adkins & Axelrod, 2001; Chambers & Rehfeldt, 2003; Tincani, 2004) along with one dissertation study (Anderson, 2001). Existing evidence is unclear about the relative effectiveness of manual sign training and picture-

based systems, including the PECS (Tincani, 2004). Tentative support would suggest that manual sign training may be a better choice for students who possess fine motor imitation skills (Anderson, 2001; Tincani, 2004), the PECS may be a better choice for students lacking adequate fine motor imitation skills or possessing moderate/severe impairments in cognitive ability and language (Gregory et al., 2009; Seal & Bonvillian, 1997; Tincani, 2004), emergence of vocal mands may be more a function of pre-existing vocal imitation skills rather than a particular communication modality (Anderson, 2001; Tincani, 2004), and using vocal models in addition to sign language or the PECS likely produces better results (Mirenda, 2003). Altogether, further research is needed to replicate and build confidence in these assertions. No specific effort to highlight data-based decision making for choosing particular communication modalities has been proposed in the literature. However, existing efforts consistently acknowledge that deciding on an optimal communication modality is an individual decision based on a variety of child characteristics and instructional variables. The remainder of this literature review will detail the comparison studies contributing to the process of evaluating specific modes of communication, instructional variables, and learner outcomes in an effort to establish the current strengths and limitations of this research.

Key Comparison Studies of Unaided vs. Aided AAC Strategies

Currently, there are eight studies that directly compare unaided (manual signing) and aided AAC strategies (PECS, graphic symbols, communication book). Older studies focusing on manual signing and picture-based systems (not including the PECS) possess numerous flaws that limit the extent and confidence to which conclusions can be drawn. Within the past decade, four additional studies have compared the PECS to manual sign with a number of promising findings that require further inquiry. However, even these studies raise concerns regarding application to practitioners seeking an optimal communication strategy for individual students.

Manual signing vs. Picture-based systems

The first study by Rotholz et al., (1989) compared the effectiveness of manual signing and a communication book on the mands of two adolescents/adults with ASD (ages 17 and 18). Both participants attended a community-based educational and residential treatment program,

were able to initiate communication with adults, and had existing sign vocabularies (around 12 and 35-40) but exhibited difficulty articulating signs due to poor motor skills. Rotholz et al. (1989) used an ABAB reversal and multiple baseline design across students (A = sign/current modality; B = communication books). Training was conducted in a small room at school for 15-20 minutes, three to five times per week with black and white symbols of items from the restaurant menu. Both participants knew the corresponding signs for most items but did not articulate them well. Community probes were conducted one to three times per week in two local McDonalds, with the primary dependent variable being the percentage of successful requests in the community (items requested divided by the number of requested items received).

Results suggested that both individuals exhibited more requests and successful communication exchanges using communication books; however, the data suggested that one participant showed a decrease in manual signs with no change in pictures while the second showed no change in manual sign and an increase in pictures. No functional requests were made in community using sign. Prompts were essential for both students in both interventions (spontaneous and independent communication did not happen), including additional training for one student with an erratic pointing response and prompts for students to bring their communication books. A fair comparison between independent variables was limited by history (each participant had existing manual sign vocabularies), failure to incorporate a baseline condition for mastery or use of targets, potential for order effects because participants were not counterbalanced, and variation in prompting across independent variables.

Two studies were conducted on adults with ID ranging from mild to profound. In the first study, Sundberg and Sundberg (1990) compared the use of manual signing to graphic symbols with four adults with mild/moderate ID (ages 33-50) residing in a group home. Selection criteria included a moderate to severe language deficits, exhibition of manual dexterity, the ability to imitate, and the ability to follow instructions. Daily sessions of 60 trials lasting approximately 20 minutes were conducted in a small room. Targets included nonsense objects, symbols, names and signs, all of which were intended to control for verbal history and iconicity. Stimuli were randomly assigned symbols, signs, and names and training of sets was drawn randomly out of a

bag before each trial. During pre-training, two relations (tact/label and intraverbal/identify when named) for three targets were taught for each modality (topography vs. selection). Signs and symbol meanings were demonstrated. Training sessions followed correct responses with verbal praise and a penny. Correction procedures involved showing the correct object corresponding with the sign/symbol (incorrect response) and demonstrating the proper response with a verbal prompt (incorrect/no response). This study used a B-C/C-B design, with two subjects assigned to each sequence. Dependent variables included accuracy and rate of tacts and intraverbals, as well as generalization to receptive speech.

Results suggested that two participants were more efficient with manual signing and one participant was more efficient with graphic symbols. For tact relations, three of four participants were more efficient and all four were more accurate using manual sign. For intraverbal relations, three of four participants were more efficient and two of four were more accurate using manual sign. It was also noted that the tact was acquired faster than the intraverbal for the three subjects with the weaker verbal skills. Across subjects, advantages in trials to criterion and percentage of trials correct were evident for the topography-based modality (i.e., manual sign). One participant was not successful with either modality.

Several limitations were noted in the study. Internal validity is threatened by both sequence and multiple intervention interference. Because nonsense stimuli were used, a baseline condition was foregone, as even the experimenter did not know the nonsense names corresponding to nonsense signs/symbols prior to their random assignment to objects. Participants were middle-aged adults who possessed adequate motor skills and existing communication skills, which limit generalization to school age participants that may possess less prerequisite skills. It should be noted that a picture-point system was used (prior to development of the PECS system). Stimulus-selection-based strategies possess several procedural limitations that include dependence on an audience (adult must be looking at student when they point to the picture) and subsequent prompt dependence on adults to mediate opportunities to communicate.

Overall, this study provides a good theoretical inquiry into the accuracy and efficiency of learning relevant to different functions of communication and response requirements of the

learner. Specifically, participants were asked to label/identify new stimuli presented physically/visually and verbally using a picture point system or manual sign strategy. Because stimuli were created, there was control for verbal history and iconicity. In fact, this may reduce inherent advantages likely held by any communication system using pictures where participants are likely exposed to pictures more frequently as symbolic representations for objects (compared to gestures) and also to the degree that participants can generalize from a two-dimensional symbol to the three-dimensional object it represents. Also, indirect reinforcement was used during training, which is currently thought to be less efficient. This study did not have participants request the stimuli they were learning (direct reinforcement) but learn to label or identify the stimuli in exchange for pennies and therefore focused on receptive identification and labeling. This study does provide an example for how to continue examining and comparing instruction across AAC strategies using functional communication following acquisition of mands/requests.

A second study by Wraikat et al., (1991) attempted to replicate the Sundberg and Sundberg (1990) study. Seven adults with ID (ages 26-50) were included based on the same criteria used in Sundberg and Sundberg (1990). Experimental sessions were conducted in a small room in the mornings. Each session lasted about 15-20 minutes and consisted of approximately 48 trials. The same stimulus selection procedures and dependent variables were targeted with the addition of difficulty ratings used to assign and balance characteristics of stimulus targets. Stimuli used for reinforcement included praise, achievement certification cards and other preferred items. Similar procedures were also used regarding dependent variables (tacts and intraverbals), response definitions, and instructional procedures. Variations were made in counterbalancing the sequence of interventions and interspersing mastered targets into sessions as training progressed. Three participants were taught two targets in each intervention while four were taught three targets in each intervention.

Visual analysis of the results suggest five participants exhibited faster acquisition rates in the TB interventions and three participants showed faster acquisition rates in the tact relations overall. Looking at these five participants within the topography-based interventions, three showed faster acquisition for tacts compared to intraverbals while one participant showed the

reverse pattern. Similarly, four participants showed faster acquisition of tacts compared to intraverbals within the SB interventions while one other participants showed the reverse pattern. Half of the participants did not reach criterion for either SB tacts or SB intraverbals. Accuracy was better for two participants in the TB interventions.

Unfortunately, a similar design was used and, therefore, similar limitations and threats to internal validity are present. Efforts were made to eliminate sequence effects between participants but such confounds are still possible within participants. Results found more support for manual signing in terms of efficiency and receptive speech. Mixed results were evident regarding accuracy across tacts and intraverbals.

Overall, these studies are not conclusive due to methodological limitations and study-specific results. Suggestions from these studies would include increasing methodological adequacy, controlling target characteristics across independent variables, and preventing order effects by randomizing the order of IV each session/day as would be done in an alternating treatment design. These studies support the multiple dimensions and functions of communication and their manifestation in different outcomes within and between persons. In addition, the communication exchanges in these studies were adult-directed and not based on the learner's direct motivation (i.e., requests were not taught). There is limited information to be drawn regarding outcome for individuals with autism and mental retardation learning fundamental requesting skills.

Gregory et al., (2009) investigated the influence of matching and motor-imitation abilities on acquisition of requests using manual signing and exchange-based communication (EBC). Six children/adolescents with ASD and ID demonstrating little or no functional communication skills were trained in a hospital unit with three consecutive EBC and sign-training sessions of 10 trials each, alternated each day, four days a week. The same items were taught in both interventions. A single item was taught until mastery and then the next item was introduced. The procedures involved verbal and modeled instructions on the contingencies for that session, a 20-second time delay followed by a verbal prompt with model, and a 5-second time delay followed by a verbal prompt and physical guidance. Results indicated faster acquisition with EBC. The three

participants with high motor-imitation and matching mastered both systems while one of the three participants with low motor-imitation and matching mastered only the EBC system. The authors concluded that pre-existence of both motor imitation and matching skills may expedite acquisition of both systems. Limitations included the lack of baseline, the use of older students with prior exposure to either system, potential carryover effects as six sessions occurred each day and often involved the same items, lack of details regarding participant age and communication history, lack of intervention integrity data, and lack of detail about who implemented the interventions.

Yoder and Stone (2006a) conducted a group study comparing Responsive Education and Prelinguistic Milieu Teaching (RPMT) to the PECS on the effectiveness of spoken communication in 36 preschoolers with ASD. RPMT includes two components. Prelinguistic Milieu Teaching (PMT) is an incidental teaching method designed to shape up intentional communication for turn-taking, requesting, and commenting pragmatic functions (as originated in Yoder & Warren, 1998). Responsive education supports parents in playing and talking with their children. Results showed the PECS had a more rapid effect on spoken communication (acts and words) than did RPMT and particularly regarding children with high object exploration. In contrast, children with low object exploration experienced a faster and sustained effect on the number of spoken words with RPMT compared to PECS. At 6 months post-intervention, increases were maintained but no differences between interventions were evident and it is possible these effects may be at least partly due to maturation. Another study (Yoder & Stone, 2006b) showed comparative results supporting increases in overall intentional communication (joint attention, requesting, turn-taking) for both PECS and RPMT, greater increased turn-taking with RPMT than with PECS, and suggested participants with high joint attention showed greater increases with RPMT while participants with lower joint attention had greater increases with PECS (Yoder & Stone, 2006b).

Manual Signing vs. PECS

Four studies were conducted to specifically compare the use of manual signing to the P.E.C.S within the past decade and demonstrate improved methodology and experimental control compared to earlier studies comparing manual signing to graphic symbols or a communication

book. Two of these studies are dissertation studies. One study involved adults with ID and three involved children with ASD or developmental disabilities and communicative impairment. A fifth study presented earlier (Gregory et al., 2009) is included here because it involves a direct comparison of ECB and manual sign training for children/adolescents with ASD and ID.

Adkins and Axelrod (2001) conducted a single-subject alternating treatment design for a child with PDD and AD/HD. This participant had existing manual sign (3-5 items) and PECS (10-15) vocabularies along with several challenging behaviors (aggression, flopping, eloping). Daily sessions were conducted in the child's natural environment within the classroom and ended after either five correct/unprompted trials or 40 total trials. It appears that a single word was taught in each session based upon the child's preference and a field of two or three pictures was used in the PECS intervention. Different words were taught for each intervention in weeks one and two but the same words were taught in week three. The dependent variables included trials to mastery (five consecutive correct trials), mands during generalization settings (each modality was assessed for the word taught earlier that day; a correct response was scored if it occurred within 10 seconds), spontaneous mands throughout school day outside of training sessions (either modality was allowed and recorded correct if a response occurred within 10 seconds).

Results reported by the authors indicate overall advantages using stimulus selection-based procedures (PECS) compared to topography-based procedures (manual sign) in outcomes including trials to mastery (twice as efficient with the PECS), mands in generalization sessions (twice as many with the PECS), and spontaneous emissions of trained words (35 with the PECS compared to 10 with manual sign). Data from week three, when the same stimuli were taught across interventions, suggest better performance in the PECS intervention compared to the manual sign intervention in terms of trials to mastery, generalization, and spontaneous emissions.

Before such data are accepted, however, several limitations should be noted in this study. These include a lack of systematic procedures for target selection, no interobserver agreement data, incomplete descriptions of procedures in each intervention lend doubt to procedural consistency and integrity (e.g., the PECS phases were not taught, even remotely reflecting the PECS protocol), the potential for history of exposure to each modality (e.g.,

absence of baseline data or reference to specific targets mastered and whether they were included during training), inconsistent criteria during training (e.g., one third of the PECS sessions consisted of a prompted first trial followed by five consecutive correct trials, suggesting the “mass trial” format may bias results), and poor reporting of data (e.g., overall accuracy not reported). Another key oversight is that generalization and spontaneous emission data showed similar rates of change across the study between both interventions and therefore may only be different in overall levels, which could be explained by pre-existing differences in the child’s PECS and manual sign vocabularies at the start of the study. In fact, spontaneous emissions decreased overall during the study and generalized responding arguably stayed the same or slightly increased in the PECS intervention. Based on the significant weaknesses in the methods and data collection, this study contributes limited information to the research base and can only provide suggestive input.

Anderson (2001) used an adapted alternating treatments design combined with a multiple probe design for six children with ASD or Pervasive Developmental Disorder Not Otherwise Specified (ages 1-11 to 4-11; four males). Participants had no prior history with the PECS or sign and fewer than five functional expressive words. Pre-assessment (2 weeks) measures included a variety of standardized ratings scales and inventories (vocal imitation, motor imitation, play/social, joint attention, and a reinforcer assessment). Extended baselines (2-10 weeks) were implemented using multiple probes. Additional probes were conducted prior to the training of each item. Training was conducted in 10-minute sessions, alternating four per day, with two manual sign and two PECS interventions daily over 10 weeks. In addition, two daily 5-minute review sessions were held following each daily intervention to encourage maintenance of mastered items (and offset unavailability of previously mastered items).

The majority of PECS Phase I-III procedures were extended to the manual sign intervention (i.e., manding for one item present, seeking the communication partner, step-wise discriminations). Both interventions used simultaneous communication (i.e., vocal plus sign/PECS request) and avoided extraneous stimuli when presenting an item (“cookie” rather than “oh, you want a cookie”). Mastery criteria were correct performance on 80% of trials for

each level/phase of training. Items were presented sequentially and required mastery of one item before introducing the next. Sign language was taught using physical prompting, modeling, and shaping. Prompts were provided after a three second delay and faded until performed independently. The PECS intervention used similar fading procedures but the error correction procedure varied from the PECS protocol as the student was prompted and reinforced for selecting the target item.

Primary dependent variables included rate of acquisition, generalized use, correct use, maintenance, and preference of modality. One third of all data were scored by a second rater and intervention integrity was calculated for 20% of the sessions in each intervention. Agreement was strong and above 80% across all measures.

Results found that participants were “responders” in both manual sign and the PECS, with the exception of one student in the manual sign intervention, demonstrating success for AAC strategies in participants at relatively young chronological ages (1-11 to 4-11) and mental age equivalents (15-19 months). The PECS was associated with success in a broader range of children, higher rate of acquisition, and generalization to new items. Manual sign training was associated with higher levels of spontaneous initiation, eye contact and vocalization at post-intervention. Split effects were noted for maintenance of correct mands in post-intervention and generalization to new people/settings. In looking at prerequisite skills, PECS acquisition rates were associated with pre-intervention protoimperative joint attention (pointing, gaze shifting) while sign acquisition rates were associated with pre-intervention comprehension of protodeclarative joint attention (responding to another’s joint attention bids for the purposes of sharing an object or experience). Behavioral preferences for manual sign were associated with higher levels of functional play at pre-intervention. Finally, vocalizations during/after interventions were associated with vocal imitation and language production age-equivalents at pre-intervention.

This study provides the most rigorous design of existing comparison studies to date. Strengths include good internal validity, a fair comparison between both interventions in the response requirements (especially regarding discrimination- PECS Phase III), and application to a younger population, and generally positive outcomes for all students. Anderson’s study

extends a number of positive findings for both manual sign and the PECS strategies. First, all participants were successful in the PECS intervention, replicating previous findings regarding acquisition (Bondy & Frost, 1994; Bonvillian et al., 1997; Schwartz et al., 1998) in children of various characteristics and increased vocalizations (Bondy & Frost, 1994; Kiernan, 1983). Second, five of six participants were successful in the manual sign intervention, replicating previous finding in terms of acquisition (Sundberg & Sundberg, 1990; Wraikat, Sundberg, & Michael, 1991) and increased vocalizations (Miller & Miller, 1973). Anderson's (2001) findings were discussed in the context of previous research demonstrating an association between gestures and vocalization (see dissertation for details).

Additional findings relate to prerequisite characteristics of participants and corresponding outcomes although the design of this study precludes definitive interpretation. First, vocalizations at post-intervention were associated with pre-intervention vocal imitation and language production assessments, replicating previous research (Bondy & Frost, 1994; Miller & Miller, 1973). Second, generalization to new items with the PECS was faster with older children. Third, all participants in the "free choice" post-intervention condition initiated more with the PECS when the communication book was placed out. This suggested that the book cued PECS use and, without a comparable cue for manual sign use, interfered with individuals who were noted to prefer manual signs but use the PECS in this condition. When the book was removed, five of the six children did use manual signs.

However, several aspects of this study warrant question or speculation. First, training was sequential, allowing for the possibility that a particular item could stall learning of new targets. Another related limitation of the study appears to be inadequate criteria for dropping un-motivating items and extending/modifying training for items. Criteria for un-motivating items required a participant to make fewer than five initiations for it, in each of three consecutive training sessions, across two consecutive days of intervention. When participants did not initiate for items and therefore did not meet criteria, items were not considered motivating. It is unclear why some "un-motivating" items were trained longer than others. Specifically, one participant spent 40 sessions training on two un-motivating items in the manual sign intervention while only

24 sessions training on three un-motivating items in the PECS intervention prior to these items being removed. A second participant was only exposed to three items in the manual sign intervention because of an extended training on the first manual sign item that lasted 37 sessions while being exposed to eight PECS items. For participant three, manual sign item one lasted 34 sessions and was then dropped because it was not motivating. Manual sign items two and three were then learned but time ran out before other items could be introduced. In contrast, the fourth PECS item was un-motivating and training stopped after nine sessions. This participant was exposed to nine PECS items in all. Again, un-motivating items were trained for much longer times in the manual sign intervention, resulting in exposure to a comparatively greater number of the PECS items. Results for participants two and three beg the question of whether simultaneous training with necessary modifications would produce different outcomes for the manual sign intervention. Altogether, three participants were “stalled” on certain items in the manual sign intervention and it can be argued that Anderson’s results underestimated the impact of this intervention.

Training multiple targets (simultaneous training) in a single session would likely produce different results although sacrificing some degree of experimental rigor and functional control. It could be argued that training multiple targets would allow for potentially faster acquisition, more positive reinforcement for successful manding, and a more positive association between the participant and training sessions. There may also be differential interaction between how the items are presented and the communication modality used. For example, manual sign training with multiple items would require the learner to perform different topographies within the same session. While this may increase overall levels of difficulty, it would also increase focus on the unique correspondence between each item and manual sign taught. Across participants, there was never an instance in which a manual sign item did not meet mastery criteria on level three after meeting criteria on level one. In other words, failure to independently sign an item always occurred at level one, ultimately resulting in the conclusion that the item was not motivating. Moreover, every item that met criteria for level one in the manual sign intervention quickly progressed through levels two and three. In reviewing participant data for manual sign items that

would become independent, participants averaged fewer sessions to mastery on both levels two and three than on level one alone. Also, three of six participants spent, on average, three times the number of sessions in manual sign training compared to the PECS on items that would ultimately meet criteria for being un-motivating.

This would suggest a few strategies for optimizing manual sign training to include more stringent or responsive criteria for determining whether items continue to be motivating by conducting periodic preference assessments and considering adapting sign motor movements that may be too difficult and thus interfere with an individual's desire to mand for items using manual sign. Finally, when lack of motivation for an item is a potential explanation for failure to acquire the manual sign, the experimenter may consider switching the "un-motivating" item from the manual sign intervention to the PECS intervention to test this hypothesis.

Tincani (2004) compared manual sign training and the PECS for a boy aged 5 with ASD and ID and a girl aged 6 with PDD-NOS and cognitive functioning within the ID range and some vocal imitation skills. Both students had impairments in functional communication skills. The study took place daily in a public school setting with the primary investigator and a second trainer conducting sessions within special education classrooms lasting 30-45 minutes. Primary dependent variables included mands and vocalizations. All students participated in a stimulus preference assessment, 27-item fine motor imitation assessment, and baseline. IOA and intervention integrity data were collected on 27% and 26% of the sessions, respectively, and were reported at high levels.

All training involved presenting items for 5-7 trials as long as the student exhibited motivation (consumed, reached for, or attempted to mand for items). Manual sign items were presented with a manual sign model and vocal label with most-to-least prompts provided following a progressive time delay of 0-4 seconds. Mastery required 80% correct responding on 10 presentations over two sessions. Students were required to perform the correct manual sign without prompts (manual sign training) and complete training through PECS Phase III (discrimination). Each training session was followed by a post-training session to assess preference for communication modality. A picture book with all preferred item symbols was

placed in front of the student. Preferred items were presented one at a time and only independent mands (sign, PECS, or vocal) resulted in access to the item. Following training, a best treatment phase was implemented based on visual examination.

Several procedural modifications were made during this study. Student one appeared to be prompt dependent on the communicative partner's model during manual sign instruction so the procedure was modified to eliminate the modeled prompt and have the adult prompter provide a physical prompt using progressive time delay. Student two was reading words from picture symbols during post-training sessions and a reinforcement delay procedure was used to encourage word vocalizations.

Tincani (2004) asserted that prerequisite motor skills may have mediated success or failure in the manual sign intervention. Student 1 initially appeared to perform better using PECS-I. However, modifying the manual sign training to reduce prompt dependence and the emergence of a throwing behavior during PECS-I training resulted in differential performance favoring manual sign in the percentage of independent mands, word vocalizations (although this decreased during the best treatment phase while vocal approximation increased), and generalization to new persons.

For Student 2, PECS-I resulted in greater percentages of independent mands and generalization to new persons. Although an advantage was evident for manual sign vocalizations, student two only vocalized for one item in manual sign training. Student 2 quickly acquired the manual sign for truck but could not acquire signs for juice, Oreo, cookie, and slinky. Student 2 met mastery criteria to acquire five items in the PECS-I training.

Overall, Tincani (2004) drew several conclusions. First, mixed results were present regarding acquisition of requests until a time delay was used with the PECS to elicit similar levels of vocalization for one of the participants. Second, there appeared to be a relationship between prerequisite fine motor skills and performance in manual sign training, and the observation that fine motor imitation skills play a part in successful use of manual signing for mands, as suggested by other studies (Anderson, 2001; Gregory et al., 2009; Seal & Bonvillian, 1997). Third, evidence from Student 1 suggested that physical prompts, even when an individual possesses adequate

motor skills, may produce better independence when dependence on modeled prompts is evident. Tincani (2004) noted this finding to contradict recommendations by Sundberg and Partington (1998). Fourth, opportunities to respond using manual sign or the PECS ranged from 11-24 trials per day and may not have been enough to develop independent mand repertoires. Frost and Bondy (1994) recommended 30-40 trials per day using the PECS and, although no specific range has been identified for manual signing, one would elaborate that individuals have equal or more opportunities for manual signing, especially considering the complexity of skills taught at once (motor skills, identifying communication partner, discrimination). Fifth, when assessed for preference of modality, student one emitted fewer signs and vocalizations when the communication book was present despite better performance during manual sign training. Because no permanent cue is provided when assessing sign preference, this difference in performance would suggest that the communication book interfered with the use of manual signs, replicating similar findings by Anderson (2001). Sixth, Students 1 and 2 were observed to show higher vocalizations in manual sign training, a finding also reported by Anderson (2001). Both students were observed to vocalize after performing manual signs, which was the contention of Sundberg (1993) that manual signing, as a topography-based system, produces unique manual signs that have a one-to-one correspondence with actual objects and may subsequently function as self-prompts for vocalizations. A final advantage of this study is that it was conducted within a public school setting, albeit in a self-contained special education classroom. Other studies were conducted in a private/clinical setting (Anderson, 2001; Gregory et al., 2009) by more specialized service providers.

A key limitation of this study was that it did not attempt to equate methodological components of the interventions. In addition, attributing better performance for Student 2 occurred with the PECS intervention is not a fair conclusion. Expectations are higher to produce manual signs than to exchange pictures without having to discriminate them (PECS Phase I). Student two quickly learned to perform the sign for truck but was unsuccessful at learning other signs. In PECS-I, student two learned to exchange pictures for a range of items; however, discrimination was not required at this point. In effect, this student received multiple credit for the

same behavior topography, handing a picture to the adult (PECS-I). Without extending training until PECS-III, one cannot be sure, one way or another, whether requiring discrimination (PECS-III) would have stalled learning, as it seems to partially have done with manual sign.

The Chambers and Rehfeldt (2003) study compared manual sign to the PECS with four adults (ages 19-40) with severe/profound ID. Training occurred at least 3 days a week in an isolated room within participants' training centers and lasted approximately 30-40 minutes. An alternating treatments design was used with randomized treatments separated by a minimum of five minutes. The same items were taught in both manual sign and PECS. No verbal prompts were used during training. Participants were taught two mands simultaneously within each modality with mastery criteria (80% over at least one 10-trial training block) to progress from levels 1-3 in each modality. Mastered mands were kept in the training mix to provide continued access during training. Instruction led to increased requesting in both interventions (with the exception of one participant in the manual sign intervention) and faster acquisition rates occurred for all four participants in the PECS intervention compared to the manual sign intervention. This study provides additional support for the effectiveness of the PECS and partial support for the effectiveness of manual sign (two of four participants learned manual sign for all four targets). However, better efficiency regarding target acquisition was observed during the PECS.

Serious limitations of this study include potential carry over effects due the use of the same targets in each intervention and failure to control for history in terms of exposure to the independent variables. Interestingly, teaching participants the same targets for both interventions would uniquely control for reinforcer motivation and other characteristics of the items but is offset by potential carryover effects. Therefore, results should be interpreted with caution.

Finally, Gregory et al. (2009) conducted a study similar to Chambers and Rehfeldt, comparing acquisition of the same items using ECB and manual signs with an added analysis of the role of matching and motor imitation skills in response to training. Gregory, DeLeon et al. found faster acquisition with EBC and concluded that both motor imitation and matching skills may expedite acquisition of both systems. Similar limitations existed that included carryover

effects, inability to control for participant history and exposure to interventions, and lack of intervention integrity.

Conclusions

Current Status of Communication Research Modalities

Machalicek et al. (2008) conducted a review of single subject school-based instructional interventions across core domains and found only 11 studies that addressed communication skills within a school setting. More specifically, targeted outcomes focus on VOCA (n = 4), speech (n = 3), gestures (n = 1), symbol identification (n = 1), gestures and speech (n = 1) and a comparison of PECS and manual sign (n = 1). General results were reported to be positive although less than half of all school-based interventions assessed generalization, maintenance, or social validity. This effort highlights the overall lack of school-based research for communication strategies, more specifically regarding the efficacy of various modalities, comparisons between modalities, and important outcomes related to generalization, maintenance, and social validity.

Evaluating research across multiple sources, two general strategies appear to hold sufficient support for their use in teaching early communication skills to children with autism and mental retardation. Visually based strategies using picture icons and gestural strategies involving manual sign have demonstrated success in their application. The current opinion in the field is that the PECS strategy provides advantages in terms of application to a breadth of individual characteristics or abilities (Chambers & Rehfeldt, 2003; Tincani, 2004; Bondy & Frost, 2002; Gregory, DeLeon, and Richman, 2009) rate of acquisition (Anderson, 2001; Chambers & Rehfeldt, 2003; Gregory, DeLeon, and Richman, 2009; Tincani, 2004; Schlosser & Sigafos, 2006), and initiations during free choice (Anderson, 2001; Schlosser & Sigafos, 2006). In contrast, manual signing provides advantages in terms of eye contact (Anderson, 2001; Schlosser & Sigafos, 2006) and possibly increased vocalizations (Anderson, 2001; Tincani, 2004; Schlosser & Sigafos, 2006).

Additional research is needed to verify the above claims and extend evidence of external validity across the diverse abilities inherent in populations of children with ASD and ID.

Practitioners, however, are left to rely upon personal experience and bias when faced with the

task of deciding upon an appropriate communication system. It is imperative that such decisions are individualized, based on sound methodology, and ultimately rely on individual responsiveness to empirically supported interventions. Unfortunately, no specific focus has attended to the individualized, data-based decision making process when attempting to select an optimal communication mode for an individual student. Existing evidence is suggestive but not definitive about the relative effectiveness of manual sign training and PECS training (Tincani, 2004). Current research suggests the best way to compare these two strategies is to use an alternating treatment design with carefully assigned targets for which participants are motivated to request and communicate.

Current Status of Communication Research Methodology

Common threads and evidence are shared between the AAC literature and contemporary ABA approaches that highlight a number of procedures considered to be best practice in teaching communication to children with ASD and ID. However, Landa (2007) outlines the key components of contemporary approaches incorporating ABA principles as those that emphasize the student's motivation to communicate (mands, topics and activities that are preferred and selected by the child), focus on literature and principles of behavior (ABA), facilitate spontaneous language, view the child as an active communicator, incorporate natural rewards and contingencies, embed instruction within natural environments, and focus on facilitating spontaneity and increasing the duration and frequency of opportunities to respond. These elements are largely embedded into AAC strategies and comparative studies focusing primarily on manual sign and picture-based strategies as independent variables.

However, there may be as many variations of manual sign and picture-based procedures as there are investigations. Even with the PECS strategy that publishes a specific set of procedures and data collection sheets, researchers have incorporated modifications or abbreviations to certain procedures that may appear to be overly elaborate or rigid. Conversely, researchers have added components to an already heterogeneous manual sign training protocol in order to make comparisons more equitable. Therefore, there is a need to sift out the critical components of communication training and reduce the methodology to a more "user friendly"

sequence that can be applied in natural settings within the reality of existing resources to a variety of communication modalities or strategies. This can be partly accomplished by separating “form” from “function”. One must account for the potential interactions between the modality and the way it is taught. Research should focus in on attributing success or failure to one or the other because a successful outcome may not be replicated across students if these details are not delineated. A single procedural sequence may be effective across modalities and would provide a number of benefits to be sought as mentioned above.

Current research emphasizes the importance of teaching students to request preferred items as the initial communication skill (i.e., using specific reinforcement based upon student motivation), providing verbal feedback by labeling items upon delivery (i.e., simultaneous communication training), and using physical prompts during initial instruction with some type of fading procedure. Consideration should also be given to daily opportunities to respond, particular motor difficulties associated with manual sign and when modifications should be made, and programming for generalization. Machalicek et al. (2008) noted in their review that some school-based studies modified instructional protocols to meet the needs of students with more severe levels of ASD or with concomitant intellectual disabilities.

Current Status of Communication Comparison Research

Accomplishing a single, concise methodology would also provide a sharper focus when applied to comparative research. Currently, several methodological details have been highlighted that may interfere with a true comparison between these two strategies where participant expectations may not have been equitable in terms of requiring discrimination in PECS Phase III (Tincani. 2004) or having targets presented sequentially to be mastered one at a time (Anderson, 2001; Gregory et al., 2009), or teaching the same items in both interventions (Chambers & Rehfeldt, 2003; Gregory et al., 2009). Several authors have reviewed the entire research base on AAC strategies and have consistently cautioned the consumer from drawing conclusions from a large but flawed body of research (Tincani. 2004; Miranda, 2003; Schlosser & Sigafoos, 2006). Current research has not definitively identified one specific AAC strategy (e.g., manual sign training, PECS) to be universally better than the other and practitioners are left with a

disorganized and bipartisan paper trail that is of little consequence to making empirically-based decisions regarding what strategy to use with particular students. Recent efforts to determine preference based on individual “choice” (Van der Meer et al., 2011) indicates support for embedding opportunities for self-determination within studies by assessing individual preferences for AAC options.

Current studies have used different procedures and variations of independent variables (modifications to procedures outlined in the PECS manual have been different across studies, as are specific instructional details in manual sign training). When attempting to apply these studies to young students with ASD and ID in a public school setting with limited resources available, personnel are left with little direction for making empirically-based decisions about what strategy to use with particular students (Goldstein, 2002; Landa, 2007; Schlosser & Sigafos, 2006; Tincani, 2004). Instead, specific knowledge, experience, preference of stakeholders involved is most likely to dictate the particular strategies and procedures to be used. Therefore, it is imperative that efforts to unify various bodies of research and empirically-based procedures address the construction of a parsimonious and fair procedure to compare potential communication strategies and evaluate individual responsiveness.

Purpose

Current research comparing two potential AAC options is limited regarding the equity of existing comparisons and the complexity and variation of existing methodologies. It is paramount that practitioners have a means to compare various communication strategies and make data-based decisions based on individual student characteristics, needs, and responsiveness to instruction. Ultimately, it would be beneficial to develop a singular, concise, and systematic protocol for comparing different AAC options using a data-based decision making process that is necessitated by the highly individualized nature of students with ASD and ID.

The primary purpose of this study is to provide a method for teachers in public education settings to identify an optimal modality for students with ASD and/or ID who have limited or no functional communication by comparing the relative effectiveness of using pictures and manual signs to request highly preferred items. A review of best practices is incorporated and embedded into the instructional protocol in an effort to provide a concise and feasible methodology for teachers to implement. In addition, this study will build upon a small but growing body of research comparing the relative effectiveness and efficiency of using pictures and manual signs in the acquisition and generalization of requests and vocalizations for early communicators with ASD and ID.

CHAPTER 3

METHOD

Participants and Recruitment Procedures

The investigator contacted teachers, paraprofessionals and administrators representing all school districts (urban and suburban) and the Intermediate Unit that provides special education services within a southeastern Pennsylvania county. Each individual was provided a written description of the study, the criteria for potential students to be nominated, and a consent form with a brief outline of the efforts required by adults and students participating in the study (see Appendix A).

Teachers and paraprofessionals who consented to participate were asked to nominate students they considered to be eligible for this study based on the following criteria: (a) an independent diagnosis or educational classification of Autistic Disorder, Intellectual Disability, or Pervasive Developmental Disorder Not Otherwise Specified; (b) no established communication system; (c) no formal training or current ability to communicate with manual signs or picture communication; and (d) motivation for a minimum of six items (e.g., food, objects) as determined by a preference assessment where students show motivation by engaging with various items. Exclusion criteria were: (a) presence of a disability (e.g., Prader Willi Syndrome, visual or hearing impairment) that would interfere with the potential use of edible reinforcement or working within intensive individual instruction; (b) individuals with more than three functional expressive word vocabularies; (c) evidence of formal training or the ability to currently use pictures or manual signs to communicate; and (d) individuals with severe impairments in fine motor skills that could inhibit their ability to manipulate materials or perform manual signs.

Four children, ages 3 to 8 years old, from four different classrooms participated in the study. For these students, consent forms were first sent to their parents that described details including the purpose of the study, the adults who would be involved in the interventions, the specific interventions, the use of video recording, and potential risks and benefits to students participating in the study (see Appendix B).

Upon receipt of parental consent, informal discussion with teachers and informal observations of students were conducted by the investigator to confirm the selection criteria were met. The length of the study ranged from 9-16 calendar weeks (9, 10, 14, & 16) for each participant. More time was required for cases where there were frequent interruptions due to holiday breaks, weather, or student absences.

All sessions and assessments were conducted in the schools and classrooms that participants attended. Assessments and intervention sessions were conducted in the student's special education classroom. Generalization probes were conducted in the special education setting and other familiar settings that participants typically occupied within the daily routine (e.g., cafeteria, snack time in another special education classroom). Special education classrooms typically contained up to eight students with services provided by one special education teacher, approximately three to six support staff, and weekly visits from related service staff including speech therapists, occupational therapists and/or assistants, and physical therapists.

Hannah

Hannah was an 8-year-old, Caucasian female with diagnoses of epilepsy, Intellectual Disability, and Autism. She was eligible for special education services under the category of Multiple Disabilities and attended an MDS-behavioral classroom located in a large, suburban school district. Her records noted significant seizures and physical complications regarding alertness and functioning. However, these conditions were recently managed by medication, and no seizures occurred in school or at home during the study. Based on parent and teacher ratings, Hannah's adaptive behaviors were Extremely Low (ABAS-2 with GAC of 40 and 40), she was rated with an "Extremely Likely" probability of having Autistic Disorder (GARS-2 with Autism quotient of 98 and 91), and significant impairments in cognitive functioning precluding the ability to attain a valid IQ score on various instruments (WNV, DAS-2, Leiter-R). Hannah's fine motor imitation assessment score of 2 indicating low fine motor imitation skills.

Hannah was primarily non-vocal, although she would occasionally emitted basic sounds or expressed herself with some noises. Her attention to objects and activities was typically brief. History of communication training was reported to include use of photographs to show highly

desired items(e.g., wagon), exposure to picture icons representing her activity schedule, and pairing of picture icons with leisure activities, songs to choose during daily groups, and edible items during snack time.

Mandy

Mandy was an 8-year-old, Caucasian female attending a life skills program in a small, suburban school district. Mandy was found eligible for early intervention services due to greater than 25% delays in the areas of cognitive, fine motor, gross motor, adaptive, personal/social, expressive language and receptive language (as indicated by the BDI-2 and PLS-4). She has medical diagnoses of PDD and expressive language delay from a developmental pediatrician and cognitive delays and expressive language delays from a licensed psychologist. On the GARS, parent ratings indicated a probably likelihood of autism (AQ = 83) but teacher ratings did not (AQ = 64). Standard scores based on parent ratings indicated a “Very Likely” probability of autism on Stereotyped Behaviors (8, 25th percentile) and Communication (8, 25th percentile) and teacher ratings indicated a “Possible” likelihood of autism. On the Differential Ability Scales- Second Edition, Mandy attained a Special Nonverbal Composite score of 52 (0.1 percentile) and a Nonverbal Reasoning Cluster standard score of 77 (6th percentile). Mandy also attained a raw score of 3 (0.1 percentile) on the Bracken Basic Concepts Scale-Receptive version. She was eligible for special education under the disability category of Intellectual Disability and Speech/Language Impairment, and was placed in a life skills classroom. Mandy’s score of 52 on the fine motor imitation assessment indicated high fine motor imitation skills.

Mandy inconsistently vocalized with articulation difficulties. She expressed basic wants and needs by pointing to objects or taking an adult’s hand and leading them to an area. Mandy responded yes and no by nodding or shaking her head, signed “more”, and vocally produced some sounds (e.g., “uh oh”) but not on a consistent basis. She requested attention and some items/persons by gesturing, looking, or vocalizing, but she was inconsistent, did not persist beyond an initial effort, and frequently relied on adults to step in and meet her needs. Mandy was primarily motivated by attention and edibles. She exhibited social awareness and communicative intent, but did not reliably use an effective or conventional mode of communication.

Nelly

Nelly was a 5-year-old Caucasian female diagnosed with Intellectual Disability. Mandy was found eligible for early intervention services due to greater than 25% delays in the areas of cognitive, fine motor, gross motor, adaptive, personal/social, expressive language and receptive language (as indicated by the BDI-2 and PLS-4)..She was eligible for special education services under the category of Multiple Disabilities including Intellectual Disability and Speech/Language Impairment, and attended a regular education kindergarten in a small, suburban school district. Nelly's score of 0 on the fine motor imitation assessment indicated low fine motor imitation skills.

She had no functional communication skills, made sounds but did not formulate functional speech sounds, and sometimes pointed, or direct non-specific sounds, to adults when she wanted something. Nelly would indicate preferences by accepting items offered or reaching for items she wanted. She would reject or ignore offers for items she did not want, sometimes turning her head away. History of communication training included vocal modeling of items, choosing among two items presented, and pairing of activities and items with picture icons during speech sessions in early intervention and in the kindergarten classroom. No formal training using sign language or picture exchange was reported by the parents.

Liam

Liam was a 3-year-old, Hispanic-Caucasian male, with a diagnosis of Autism. He was eligible for special education services under the disability category of Developmental Delay and Speech/Language Impairment and was being provided early intervention services in a large suburban school district. Mandy was found eligible for early intervention services due to greater than 25% delays in the areas of cognitive, fine motor, gross motor, adaptive, personal/social, expressive language and receptive language (as indicated by the BDI-2 and PLS-4). He was capable of multiple utterances and could repeat the alphabet, count to 10, and sing along with music, although his vocalizations were primarily echoic or scripted in function. Liam engaged in frequent challenging behaviors that included dropping to the floor, head butting, throwing himself back in his chair or onto the ground, and crying, whining, and screaming. These behaviors primarily occurred when he did not have access, was denied access, or if access was interrupted

(even briefly) to preferred stimuli. In these situations, Liam would quickly become frustrated and did not attempt to communicate vocally or through other means except to grab or briefly look at staff. Liam had limited attention that would quickly move from one object/activity to another. Liam's score of 0 on the fine motor imitation assessment indicated low fine motor imitation skills.

History of communication training was not reported in the home setting and Liam had not received services prior to entry in the early intervention program. The classroom used picture icons to represent scheduled activities, edibles during snack time, and specific items of focus during group activities (e.g., articles of clothing when taking turns dressing a character). Prior to intervention, Liam would approach adults, take their hand, and lead them to desired items or areas where he needed adults to facilitate access to desired items (e.g., get a toy from the cabinet or off of a high shelf). These observations suggest that Liam possessed the general understanding that some action (whether leading an adult or requesting with a manual sign or picture) was required prior to gaining access to a preferred item and activity.

Intervention Teams

For each participant, the intervention team consisted of one special education teacher and one paraprofessional, with the exception of Nelly where a second teacher working as a paraprofessional assisted with the afternoon sessions. Hannah's team consisted of a special education teacher with a master's degree and 8 years of experience working with individuals with developmental disabilities, and a paraprofessional with a high school diploma and 4 years of experience working with individuals with disabilities. Mandy's team consisted of a special education teacher with a bachelor's degree and 7 years of experience working with individuals with developmental disabilities, and a paraprofessional with an associate's degree and 1 year of experience working with individuals with disabilities. Nelly's team consisted of a learning support teacher with a master's degree and 8 years of experience working with individuals with learning disabilities, a paraprofessional with a Pennsylvania teacher's certification and bachelor's degree and 5 years of experience working with individuals with developmental disabilities (she also had 10 years of experience teaching elementary regular education, experience tutoring students with learning disabilities in reading, and a paraprofessional with an associate's degree and 1 year

experience working as Nelly's one-to-one support staff. Liam's team consisted of a special education teacher with a bachelor's degree and 10 years of experience working with individuals with developmental disabilities, and a paraprofessional with an associate's degree in early childhood education, a "highly qualified" state certification, and 4 years of experience working with individuals with developmental disabilities.

Materials

Materials included picture symbols (Board Maker program, Google images, or actual pictures or wrappers of food items), three ring binders or other small booklets with Velcro strips for storing and manipulating various pictures, and a variety of toys and edibles used for training items. Materials used with each student are described in more detail later in the context of the procedures.

Experimental Design

A single-subject alternating treatments design, with a baseline phase and generalization probes, was used to compare the effects of communication instruction using manual signs and pictures. Because the responsiveness of individuals with developmental disabilities to communication training has been shown to be highly unique, this single-subject design was employed in order to examine individual differences in response to each communication mode. Alternating treatments were used with each individual serving as his/her own control. The design incorporated a baseline phase for the purpose of establishing levels of pre-intervention responding; during the next phase, the two modes of instruction were alternated in an attempt to identify any differential effects. Experimental control was demonstrated through visual analysis of graphically displayed data to determine differential changes in level upon introduction of each intervention and separation in the data paths associated with each intervention (differential intervention effects). Interventions were randomly alternated and separated by at least 90 minutes, performed on the same day, 1-5 days per week. Sessions were conducted during naturally occurring activities in which preferred items were available and students were naturally motivated to request them (snack time, free play).

Dependent Variables

There were two sets of primary dependent variables in this study, efficiency and effectiveness. Efficiency was defined as (a) the average number of trials/sessions to mastery of independent requests, (b) the percent of independent requests per session, and (c) the average number of trials/sessions to mastery of discrimination. Effectiveness was defined as (a) the number of items meeting mastery criteria for independent requests, (b) the percent of nonoverlapping data (PND) between baseline and intervention, (c) the average percent of independent requests over the course of training, (d) the number of items meeting mastery criteria for discrimination, and (e) the average percent of discrimination over the course of the study. Secondary dependent variables included the average percent of vocalizations per session and over the course of intervention and the frequency of items for which spontaneous requests, person generalization, and setting generalization occurred.

In the picture intervention, an *independent request* was defined as the student, when preferred items were in view, taking the correct picture/symbol off the Velcro strip on the communication book and contacting the Giver while holding that picture without prompting (e.g., touch picture to adult's side or hand, hold picture in one hand and contact the adult with the other hand, or push picture within arm's length of the Giver within their line of sight). If the student selected the incorrect picture icon, failed to deliver the icon to the Giver within 3 seconds of selecting it, or otherwise did not complete the select and deliver sequence, this was scored as an *error*. *Discrimination* in the picture intervention was defined as the student, following a request, taking the corresponding item offered among a pair of preferred items.

In the manual sign intervention, an *independent request* was defined as the student, when preferred items were in view, emitting the corresponding manual sign while facing in the general direction of the Giver without prompting. All manual sign formations were discussed based on the essential elements required with examples of acceptable and unacceptable formations. If the student performed a motor sequence different than the manual sign or prompting was not delivered within 3 seconds, this was scored as an *error*. *Discrimination* in the

manual sign intervention was similarly defined as the student, following a request, taking the corresponding item offered among a pair of preferred items.

For both picture and manual sign interventions, *spontaneous requests* were highly similar to independent requests except that they occurred when preferred items were not in view and, specific to the picture intervention only, when the communication book was not in direct view of the student (i.e., book is closed and placed off to the side of the student rather than directly in front of the student and open with icons readily visible).

Vocalizations were defined as the student, at any time during intervention or when preferred items were in view, emitting specific vocal sounds corresponding to unique objects that could be recognized as an approximation of at least one of the elemental sounds of that word. For example, when Mandy was presented with a ball, “bah” was an acceptable approximation but “mah” was not. It should be noted that vocalizations functionally served as requests, but were distinguished from other request forms in this study to examine potential intervention differences.

Generalization probes examined whether requests occurred with novel adults who were not involved in instruction (person generalization) or in different, non-intervention settings (setting generalization). For each person or setting, items requested when not in sight were scored as both spontaneous requests and either person or setting generalization.

Measurement and Recording Procedures

Primary data collection was conducted by the intervention team. IOA and intervention integrity data were collected by graduate students reviewing a randomly selected sample of videotaped sessions. Parents and teachers provided consent to videotape all intervention sessions. All intervention sessions were videotaped with only a few exceptions due to technical difficulties or supply limitations. Data for baseline sessions were recorded on the Baseline Data Sheet (Appendix C). Each trial was marked with a line if the student accepted the item offered, or marked with an “X” if the student rejected or did not respond to the item offered. Other student responses were recorded if the student gave the appropriate manual sign (“S”), exchanged the appropriate picture icon (“P”), vocally requested the item using the word or an approximation of

the word (“V”), or emitted other vocal sounds that were not word approximations of the item (“NW”). If challenging behavior occurred, it was tallied and briefly described.

Similar recording procedures were used for all intervention sessions and generalization probes. During picture intervention, validations and intervention trials were recorded for each of the three items (see Appendix D). First, validations were recorded for items each time they were selected or rejected (when neither item presented was selected, resulting in two rejections at the same time). The first time an item was selected or rejected, the number 1 was circled or crossed out, respectively, with subsequent trials corresponding to numbers 2-5. For all intervention trials, performance was scored for both steps (select icon and deliver icon) based on whether the student required full physical prompting (“FP”), partial physical prompting (“PP”), or independently completed the step (“I”) as well as the occurrence of word (“W”) or non-word vocalizations (“NW”). In addition, discrimination was recorded on the first trial for each item (Appendix D) as correct (circled “Yes”) only if the participant independently, without prompts or assistance from the Giver, selected the item that was requested. All other responses were considered incorrect (circled “No”). Trials with errors were immediately terminated and marked with an “X” corresponding to the particular step and prompt level where the error occurred.

During manual sign intervention, identical scoring procedures were used for validations and intervention trials (see Appendix E), with two key differences. First, only one step was required for manual sign requests, as compared with two steps for picture requests. Second, a note was made for items that incorporated a modified sign with a brief description of the modification agreed upon and defined prior to instruction.

The percent of independent requests (picture, manual sign, or vocal) per session was calculated by dividing the number of independent requests by the total number of trials presented across items for each intervention. The same calculation was conducted to determine the percent of vocalizations per session. The average number of trials to mastery of independent requests was calculated by counting all instructional trials for each individual item through the final session in which mastery criteria was achieved. The average number of trials and sessions to mastery of discrimination was calculated by counting all trials and sessions for each item

leading up to the final session in which mastery criteria were achieved. For generalization probes, a frequency count was conducted for spontaneous requests with person generalization and spontaneous requests with setting generalization.

Interobserver agreement was calculated by conducting trial-by-trial correspondence as to whether student responses were prompted or independent, whether or not vocal approximations occurred, and whether discrimination occurred on the one-time probe for each item and session (see Appendices D & E). The total number of agreements was divided by the total number of agreements and disagreements and then multiplied by 100 to obtain a percentage of agreement for each intervention and dependent measure (independence, vocalizations, and discrimination).

Intervention integrity was calculated by reviewing video and indicated whether or not (“yes” and “no”) a number of general conditions were present during training and whether specific intervention steps and prompting procedures were followed for individual items for the first five trials in each session (see Appendices F & G). The total number of “yes” scores was divided by the total number of “yes” and “no” scores and then multiplied by 100 to obtain a percentage of integrity for each intervention.

Generalization probes were conducted on the first week of intervention and then resumed on a weekly basis once mastery criteria were met for the first item in either intervention. Two different probes were conducted, one per week, varying the intervention conditions by having a novel adult serve as the Giver or conducting the probe in a different setting. Probes were alternated on a weekly basis but always started with the items out of sight such that spontaneous requesting was assessed weekly and person or setting generalization was assessed biweekly. Items requested when out of sight were scored as both a spontaneous request and person or setting generalization. Items that were not spontaneously requested were then enticed by the Giver to solicit an independent request that was scored as either person or setting generalization. Probes were scored on the Generalization Probe Data Sheet (Appendix H). Data were reported as the frequency of probes in which generalization was demonstrated for each type (spontaneity, person, and setting).

All generalization probes occurred at least one hour after intervention and most occurred a day removed from intervention (generalization probes were often conducted at the beginning of the day prior to intervention). In addition to direct observation data, a brief set of questions was answered in which anecdotal data were recorded regarding student requests outside of the intervention context during short weekly interviews with the teacher (see Appendix H).

Procedures

Preference Assessment

Prior to baseline, a preference assessment was conducted to determine which items were preferred by each participant. Items to be assessed were selected based upon input provided by parents and school personnel, as well as informal direct observation of the student in the natural setting.

The preference assessment was conducted by the investigator and teachers on 2 different days. While the child and Giver were seated at a table, items were presented, two at a time and in random order, until all paired combinations were used. Items were presented to be equally accessible (same distance and height from participant) while an observer recorded the participant's selection (See Appendix I). The participant could only choose one stimulus from the pair and any attempts to access both simultaneously were blocked and resulted in presenting both stimuli again. Following the assessment, items were ranked according to the number of times each was selected across all pairings. Specific procedures and details are described in more detail in the teacher manual (see Appendix J).

The preference assessment was modified for Liam to avoid frustration and behavior in one major way. Rather than a forced-choice assessment (offer two and allow one to be chosen), sequential presentation of items was conducted (Tincani, 2004) and Liam's response was scored as positive or negative. Ongoing presentations occurred across items for two sessions and then the items were ranked and assigned following similar procedures as with the other participants.

Fine Motor Imitation Skills Assessment

Twenty-seven items comprising a hand fine motor imitation assessment from the Assessment of Basic Language and Learning Skills (ABLLS: Sundberg & Partington, 1998; see

Appendix K) were used to provide a general description of the fine motor imitation skills for each participant. This assessment does not offer psychometric properties but is presented as a curriculum guide based upon a developmental sequence comprising skills typical acquired through the kindergarten year of childhood. Each formation was presented to the child with verbal instruction to “do this.” Each formation was scored as *correct* (2 points) if the child imitated the stimulus clearly, *partially correct* (1 point) if the child approximated all or part of the fine motor skill, and *incorrect* (0 points) if the child did not respond, attempt to imitate, or approximate any identifiable portion of the motor skill sequence. Scores were tallied and categorized as low (0-18), average (19-36), or high (37-54) fine motor imitation skills.

Assessments were conducted over several days and consisted of the teacher or investigator catching the student's attention and then showing a fine motor formation while saying “do this” and looking directly at the student. If the student did not attend or was distracted, another attempt was made. Hannah's fine motor imitation assessment score of 2 was low. Mandy score high on the fine motor imitation assessment (score of 52). Nelly's and Liam's performance on the fine motor imitation assessment were low (zero out of 54). Liam often did not appear to understand the expectation of imitating fine motor movements, or was not motivated to do so (score of zero out of 54). On few occasions, he was reported to appear to imitate a couple fine motor movements but he rarely did so accurately.

Item Assignment

All items were first rank ordered by magnitude of preference. One intervention was assigned items 1, 4, and 5 while the other intervention was assigned items 2, 3, and 6, with the following considerations. No more than one item with a similar topography was assigned to the manual sign intervention and items with similar visual icons were not assigned to the picture intervention. The result was that interventions were balanced by item category and overall preference rankings. An example is provided in Appendix L, where *one of two items equally preferred* was chosen based on sweet vs. salty/crunchy characteristics.

Hannah. As a result of the paired preference assessment, the items assigned to picture intervention included peanut butter cracker (PCS symbol), M&M (PCS symbol), and Doritos

(emblem taken from the package). The items assigned to manual sign intervention were Sweet Tart (i.e., using manual sign for “candy”, touching cheek with pointer finger and twisting), “popcorn” (both hands alternating up and down with pointer fingers extended up), and “pretzel” (pincer grasp between thumb and pointer finger with both hands clasped in a figure 8). Due to low motivation for popcorn, Craisin (“raisin”) replaced popcorn after five sessions.

Mandy. As a result of the paired preference assessment, the items assigned to picture intervention were chip, juice, and puzzle (all PCS symbols). Items assigned to manual sign intervention included “ball” (digits of both hands symmetrically joined in the shape of a ball), “fruit” snack (hand sign for “f” touching cheek), and “soda” (open hand with palm down placed on top of other hand with a closed fist).

Nelly. As a result of the paired preference assessment, the items assigned to picture intervention included Cheez-it, Teddy Graham, and Pop Tart (all emblems taken from packages). Items assigned to manual sign intervention were “ball”, Goldfish - “fish” (right hand extending as if to shake a hand but moving to imitate the tail of a fish), and animal “cracker” (arms crossed with one hand palm up touching underside of elbow from other arm).

Liam. As a result of the paired preference assessment, the items assigned to picture intervention included animal puzzle (picture of puzzle), movie (PCS symbol), and train tracks (PCS symbol). Items assigned to manual sign intervention included crank “wheel” (open hands rotating around each other), “music” (open hand brushing back and forth over the other open hand with palm up), and “train” puzzle (pointer and middle fingers extended for both hands, perpendicular to each other, with the top hand rubbing across the other).

Intervention Team Training

Approximately 2 hours of instructor training was provided over 2 days for teachers and paraprofessionals implementing the interventions. On the first day of training, the investigator provided a general description of the methodology and overall components of intervention and then specifically reviewed the intervention integrity and instructional data sheets. The interventions were role-played with the investigator acting as the student as well as the staff-designated roles for the Giver and Prompter. The investigator provided guidance and feedback

for each step of the intervention and illustrated how the instructional data sheet would be filled out until each step could be checked off as completed without mistakes and there was agreement on the data sheet. On Day 2 of training, the same role-playing procedure was used and interventions were practiced until implementers could complete all steps from beginning to end. The general and specific steps of both interventions were scored as yes, no, or not applicable, for up to five trials/examples per item. The percent of steps completed accurately was calculated by dividing the total number of yes scores by the total number of yes and no scores for both picture intervention (Appendix D) and manual sign intervention (Appendix E). A minimum of 90% accuracy across all steps in each intervention was required prior to beginning the intervention phase. Following training, intervention teams were provided checklists outlining the procedural steps of implementation for baseline (Appendix M), picture intervention (Appendix N), manual sign intervention (Appendix O), and generalization probes (Appendix P).

Observers and Observer Training

Four graduate students from Lehigh's College of Education and one graduate student from Kutztown's counseling program volunteered to code video for interobserver agreement and treatment integrity. One hour of training was provided by the investigator in which the intervention integrity data sheets (Appendices F & G) and intervention data sheets (Appendices H & I) were presented and reviewed with demonstrations of how intervention training was implemented for both the Giver and Prompter roles. A sample video was then viewed for the corresponding student with additional demonstration, discussion, and questions. Following the training, the investigator was available by phone or email for additional questions.

Independent observers reviewed videotaped intervention sessions with the same data sheets used for initial teacher training (see Appendices D & E) an average of 33.4% (range 26.8-38.2%) for picture intervention and 43.4% (range 30.2-59.5%) for manual sign intervention. Intervention integrity was also monitored weekly by the experimenter during classroom visits in which ongoing feedback provided as needed.

Baseline

During all baseline sessions, intervention teams completing intervention were present at a table with the child within the special education classroom (see Appendix Q). The Giver was seated either directly across or at a 90-degree angle to the student and the Prompter behind the child to provide redirection to the table/activity as needed. Items from each intervention were assessed separately. For the picture communication baseline only, the child's communication book was placed in proximity with picture icons of all three items inside the book (not visible). Items were presented randomly, one at a time, with the Giver enticing the student by displaying the item, playing with the item, or pretending to eat the item for up to 5-10 seconds to observe whether specific communication attempts were made by the child to gain the item (picture exchange, manual sign, and vocalization). However, if the child engaged in other behaviors (reaching, pointing, grabbing), access was delayed for 2-5 seconds before providing the item. The child was allowed access to the object for approximately 15 seconds before it was either consumed or returned. All items were presented randomly and repeated for a minimum of three trials or until the child showed a lack of interest by not reaching for an item or pushing an item away (i.e., satiation). All baseline trials resulted in an initiation for a minimum of three trials per item but no specific communication attempts were observed. Baseline sessions lasted approximately 3-5 minutes with 3-8 trials per item or until the individual indicated satiation by not consuming or playing with the edible/object.

General Intervention Procedures

Communication intervention was typically conducted 3 or 4 days per week during naturally occurring activities within the special education classroom (i.e., snack, group table), although participants were not trained in immediate proximity of peers due to confidentiality and considerations in video recording. Sessions were randomly assigned in the morning and middle of the day, when motivation for edibles and objects tend to be naturally strong (see Appendix R). Sessions lasted approximately 10-15 minutes and included instruction on all items assigned to each intervention for 5-10 trials per item or until the individual indicated satiation by not consuming or playing with the edible/object. Intervention teams were present for each

intervention. The Giver was the person who offered and delivered preferred items to the participant, and the Prompter assisted the participant in requesting items following initiations and provided general redirection to maintain participant engagement. The Giver did not prompt the participant to request items, but enticed the student with items (showed and offered them, played with or pretended to eat them) and responded to correct requests by delivering the item, saying the name of the item, and showing the picture icon or manual sign formation for the item. The Prompter assisted the participant in performing correct requests only following some type of initiation by the participant (attempts to grab items or make requests). No verbal prompts were required during intervention. *Student initiations* indicated motivation for a particular item and included reaching for an object, attempting to request the object, staring at the object for several seconds, or other individually specific attempts to access that item. If the student did not respond at all to the Giver, did not consume or play with the item, exhibited challenging behavior when the item was received, or showed other individually identified signs of disinterest, *satiation* was assumed and instruction was temporarily stopped for that item.

Validations. Validations were conducted for the first presentation of each item in a session and again if items were returned to later in the session as a means to identify temporary motivation for items. This was necessary as all intervention was based on the assumption that items selected in the validation trial were truly desired and therefore, when requested, served as positive reinforcement for the specific requests being taught.

A validation trial started when the Giver, upon having the student's attention, presented two randomly-selected items, one in each hand, for up to 15 seconds for the student to take freely. If the student attempted to access both items, the Giver blocked or prevented access to both items and restarted the trial following the Prompter's redirection of the student (much like the procedures in the paired stimulus preference assessment). A successful validation trial was defined as the student taking one item from the pair within 10 seconds and consuming or playing with the item for a minimum of 3 seconds (marked by circling the corresponding validation trial for the selected item). No instruction occurred during validations (showing request form or labeling

of item). If the participant did not take either item, an “X” was marked on the corresponding validation trial for both items.

During validations, the participant was only allowed brief access to one item (about 15 seconds or one small bite) in order to validate its “preferred” status. No expectations were placed on the child other than to exhibit appropriate, non-challenging behavior (to prevent potentially reinforcing inappropriate behavior), and to take the item within 5 seconds of its presentation and consume or play with that item. Instruction followed with the validated item as the target and the unselected item as the distracter (item not chosen during validation trial). If the participant did not take either item, did not consume or play with an item for 3 seconds, or otherwise indicated satiation, the next pair of items was offered in another validation trial.

Instructional trials. Instructional trials began by having the Giver present the “validated” item out of reach of the child while the Prompter waited up to 15 seconds for the child to initiate (reaching for the item or picture, attempting to perform a manual sign, or other student-specific indicators). If the participant initiated but did not immediately follow the necessary action to request the item, the Prompter followed prompting procedures to assist the student to perform the manual sign or picture intervention response, using graduated guidance and prompt fading (e.g., full physical prompt, faded to a partial physical prompt, etc.). Following a request, prompted or independent, the Giver delivered the item along with the vocal label and showed the corresponding picture icon or performed the manual sign) within 1 second. For example, when prompted to request “ball” using manual sign, the Giver delivered the ball, said “ball”, and performed the manual sign for ball (digits of each hand joined symmetrically in shape of a ball). No other vocals were used (e.g., “what do you want?” “oh, you want a ...”).

If, during instructional trials, the student indicated satiation (e.g., rejected the item, exhibited challenging behavior, did not reach for or take the item, pulled away, held the item while looking around, set the item down), a validation trial for the next pair of items was conducted. Instruction continued to move from item to item until all items met minimal criteria (at least five trials) or discontinue criteria. Discontinue criteria were met when a particular item was rejected by the student during two consecutive validations or three consecutive instructional trials. Items

with three or fewer trials over three consecutive sessions were removed from intervention and replaced by additional items from the preference assessment.

Discrimination probes. To probe discrimination skills, a slight variation in intervention procedures was used for the initial instructional trial of each item. Once a request was made (independent or prompted), the Giver offered two items (identical to the two items offered in the preceding validation trial) by holding them equally within reach of the participant. If the participant reached towards the item corresponding to the request, the item was given along with its vocal label (this trial was scored as “correct discrimination”). If the participant reached toward the item that did not correspond to the request, the Giver denied access to the item and provided the item that was requested along with its vocal label (this trial was scored as “no” for the discrimination probe).

Picture Intervention

During intervention, the Prompter was seated beside or behind the child to assist in requesting but did not talk to or provide feedback to the participant. Following a validation trial to ensure the child’s interest in the item, the Prompter placed the two pictures corresponding to the two items presented in the validation trial in front of the participant. Instruction began on the validated item with a discrimination probe followed by typical instructional trials as described in the general procedures sections above. Brief access was provided following all correct exchanges/vocalizations, prompted or independent. The Giver returned the picture symbol to the field prior to starting the next intervention trial.

Prompt fading. Prompt fading used graduated guidance with physical prompts faded from the tips of the fingers and thumb, to the knuckles of the fingers and thumb, to the wrist, and to the elbow. Specifically, the prompter waited for the student’s initiation (e.g., reach for the item or picture) and then provided full assistance with both steps. During each trial, attention was given to the participant’s actions to determine when to systematically fade the prompts for the student to select and deliver the picture to the Giver. Physical assistance was faded to partial assistance as indicated by the student’s responsiveness after a minimum of three consecutive trials without an error for the “select” and “deliver” steps.

For the selection of the correct picture icon, following a student initiation, the Prompter provided full physical prompts and then graduated guidance for the student to grab the correct picture icon and pull the icon off of the Velcro strip. Once the student attempted to perform these steps independently, the Prompter allowed for independence but quickly inserted prompts if the student began to reach for the incorrect icon or struggled to pull the icon off of the Velcro strip.

For the delivery of the correct icon, the Prompter provided full physical prompts and then graduated guidance for the student to lift the picture icon, reach toward the Giver, and deliver the picture icon. Once the student attempted to perform these steps independently, the Prompter allowed for independence but quickly inserted prompts if the student did not lift the picture, reach toward the Giver, or let go or deliver the icon when within arm's reach of the Giver. The Giver did not provide any prompts during this sequence and reinforced correct requests by giving and saying the name of the item, along with displaying the correct picture icon for that item.

Errors. The student's choice during the validation trial was considered to be the "correct" response in subsequent instruction. If the participant did not correctly complete the sequence (i.e., the student grabbed the incorrect icon, emitted an incorrect response outside the two-step sequence, the Prompter failed to intervene within 3 seconds), it was considered an error. Trials with errors were immediately terminated. Specific attention was placed upon errorless prompting at the point in the sequence in which the error occurred. For example, if the Prompter had just faded guidance at the wrist to independence for the student to deliver the picture, but the student played with or manipulated the picture icon for over 3 seconds, it was considered an error. The trial ended without access to the preferred item. The next trial resumed with the Prompter ready to continue partial physical assistance during the deliver step (guidance at the wrist to lift and reach toward the Giver) for a minimum of two consecutive correct trials before reconsidering prompt fading. Prompt levels for each session started with the ending prompt level from the prior session. The participant did not gain access to the item following incorrect requests. If the child did not initiate after 15 seconds once clearly finished with the prior portion (i.e., finished chewing edible or playing with puzzle piece), no prompts were used and this was considered as satiation. The next validation trial followed.

Manual Sign Intervention

Manual sign intervention incorporated procedures similar to those employed in the picture intervention. The simplest American Sign Language (ASL) sign was used for each item. Topographical resemblance between manual sign items was minimized to prevent confusion. The intervention team discussed what specific sign formations were to be expected from each student and agreed upon examples of correct and incorrect formations. The same general procedures were used for validations, instructional trials, and challenging behaviors. The only difference was that the Prompter also ensured that the participant's hands were not "busy" prior to intervention trials (e.g., ask student to fold hands), to prevent potential confusion with specific manual signs.

Prompt fading. Prompt fading used graduated guidance with physical prompts faded from the tips of the fingers and thumb, to the knuckles of the fingers and thumb, to the wrist, and to the elbow. Specifically, the prompter waited for the student's initiation (e.g., reach for the item or picture) and then provided full assistance with both steps. During each trial, attention was given to the participant's actions to determine when to systematically fade the prompts for the student to select and deliver the picture to the Giver. Physical assistance was faded to partial assistance as indicated by the student's responsiveness after a minimum of three consecutive trials. Once the student attempted to form manual signs independently, the Prompter allowed for independence but quickly inserted prompts if the student began to reach for the item or deviated from the designated formation for that item.

Errors. As with picture intervention, the student's choice during the validation trial was considered to be the "correct" response in subsequent instruction. If the student did not complete the correct manual sign (i.e., the student performed a lesser approximation or a different motor sequence, or prompting was not implemented within 3 seconds), it was considered an error. Trials with errors were immediately terminated. Specific attention was placed upon errorless prompting at the point in the sequence in which the error occurred. Errors were handled following the same procedures as with picture intervention.

Procedural Modifications

A variation in procedures was used for Liam due to severe frustration when he was unable to immediately access a desired item/activity, complete all steps of a task, or when offered choices and only allowed to have one item. In his case, validations did not include a choice because the choice situation would sometimes cause frustration. Discrimination checks were largely omitted from procedures for Liam because they also contained a choice condition. In addition, each item was taught to completion or until he lost interest in the item and then the next item was presented for validation (accepting the item or part of the task). When movie or music had to be paused, some frustration was observed such that immediate prompts were used in order to avoid challenging behavior (for these items, student initiation was not required prior to instruction). These modifications were largely successful in minimizing learner frustration and allowing opportunities for Liam to benefit from both interventions. No other challenging behavior occurred during the study.

Due to significant behavioral challenges, several weeks were required to identify preferred stimuli that were powerful and consistent enough to motivate Liam. In addition, a few modifications were made in an effort to proactively reduce or prevent learner frustration. Based on observations and discussions regarding the function of Liam's behaviors, denied/interrupted access was considered a reliable and fast trigger for challenging behaviors. Therefore, procedures that required Liam to choose among preferred items (validations, discrimination probe) or wait briefly (discrimination probe) were eliminated. Target items were selected with consideration of "interruption" as potential triggers. Edibles were not reliable or consistently preferred by Liam based on four separate preference assessments. He was more interested in audio/visual stimuli including manipulatives, especially those that moved, made sound, or lit up.

Generalization Probes

Two different probes were conducted with either a novel adult serving as the Giver or in a novel setting (see Appendix S). All probes were open-ended in nature and began with the opportunity to spontaneously request any of the items within a specific intervention. To minimize the potential advantage of materials serving as a cue for the participant to request items in the

picture intervention, the communication book was out of direct view of the student, but within proximity with all picture icons inside the book. During the manual sign communication generalization probes, the student's communication book was out of sight and not available. Participants were directed by the Prompter to a table or area where the Giver was waiting with items out of sight. A brief greeting and eye contact was provided and then staff waited for a response or request. Spontaneity probes ceased if no requests were made within 20 seconds or all three items were spontaneously requested once. All items that were not spontaneously requested were then presented randomly, one at a time, and displayed to the participant for up to 10 seconds, to observe whether specific communication attempts were made by the child to gain the item. Successful attempts immediately resulted in delivery of the item with its vocal label by the Giver. The child was allowed access to the object for up to 30 seconds before it was either consumed or removed.

Social Validity

Following intervention, an open-ended questionnaire designed by the experimenter was given to all school personnel who were involved in implementing the study. Feedback was solicited regarding the amount of effort required, the ability implement procedures adequately, whether procedures were effective, whether the student responded better to one strategy, any professional benefits of participation, and likes, dislikes and limitations (Appendix T).

Data Analysis

A review of intervention integrity data was conducted in which the accuracy of intervention steps was reported for each participant. An overview was presented of overall intervention length and duration in terms of trials and sessions for each item. The percentage of general intervention steps followed along with specific item training steps was calculated for intervention integrity. Interobserver agreement was calculated separately for independence, vocalizations, and discrimination.

To determine which mode (pictures vs. manual signs) resulted in more efficient learning of independent requests (Research Question #1a), two analyses were conducted. First, a line graph for each participant displaying session-by-session data of the average percent of

independent requests across items for each intervention. Visual inspection focused on stable and zero-level responding during baseline, a separation in data paths from baseline upon introduction of each intervention, and a separation in data paths between interventions for each individual participant. Secondary analysis was conducted using the number of trials to mastery of independent requests for each item. Visual inspection focused on individual intervention differences for each participant as represented by overall differences in frequency between each set of three items.

To determine which mode (pictures vs. manual signs) resulted in more efficient learning of discrimination (Research Question #1b), the number of trials and sessions to mastery for discrimination was calculated. For both picture and manual sign intervention, the criterion for independent requests (using pictures, manual signs, or vocalizations) for each specific target was a minimum of 80% of trials over three consecutive sessions for each item. Visual inspection focused on individual intervention differences for each participant as represented by overall differences in frequency between each set of three items (no data available for Participant 1)

Effectiveness of learning independent requests (Research Question #2a) was determined by three analyses. First, the number of items meeting mastery criteria for independent requests was calculated with visual inspection focusing on differences in frequency between interventions for each participant. Second, the PND from baseline to intervention for each participant and intervention was calculated by dividing the total number of intervention sessions exceeding the highest baseline data point by the total number of intervention sessions. Visual inspection focused on differences in magnitude between interventions for each participant. The final analysis calculated the average percent of independent requests for each intervention with visual inspection focusing on differences in magnitude between interventions for each participant.

Effectiveness of learning discriminated requests (Research Question #2b) was determined by the number of items meeting mastery criteria and the average percent of discrimination for each intervention. The criterion for discrimination was correct responding on initial instructional trials over three consecutive sessions for each item. Visual inspection focused on differences in frequency and magnitude between interventions for each participant.

Vocalizations (Research Question #3) were calculated-by-session data for each participant comparing the percent of trials per session in which these skills occurred across items in both interventions. Visual inspection will focused on a separation in data paths between interventions for each individual participant.

Generalization data (Research Question #4) were calculated as the frequency of items scored as spontaneous requests, person generalization, and setting generalization for each intervention and participant. Visual inspection focused on differences between interventions (pictures and signs) on each of three skills. Additional review and summary of anecdotal information collected on weekly teacher interviews was used to ascertain additional differences in individual response to interventions.

Finally, a descriptive review of social validity was conducted to obtain impressions on the feasibility, effectiveness, and overall satisfaction with participation in this study.

CHAPTER 4

RESULTS

Interobserver Agreement and Intervention Integrity

Data for percent of interobserver agreement (IOA) and intervention integrity are displayed in Table 1. Percent IOA for independent requests was similar although less variable for picture intervention (range, 84.4-93.9%) than for manual sign intervention (range, 80.9-96.8%). Percent IOA for discrimination was higher for picture intervention (range, 87.0-93.3%) than for manual sign intervention (range, 80.8-88.2%). Percent IOA for vocalizations was higher for picture intervention (range, 95.9-100.0%) than for manual sign intervention (range, 92.6-96.3%). Mean intervention integrity levels (range, 89.6- 98.1%) were above 95% for all participants in both interventions, with the exception of manual sign intervention for Mandy (89.6%).

Table 2 displays the number of intervention trials and sessions administered for each participant and intervention. Most participants experienced equivalent opportunities across items and interventions, although Hannah received more instruction with picture intervention than with manual sign intervention due to inconsistent motivation for items over a 2-week period in which she was ill.

Research Question 1

RQ1a: Using a single communication instruction method, which mode (pictures vs. manual signs) results in more efficient learning, as measured by the percent of independent requests per session and the number of trials to mastery for independent requests.

Percent of independent requests. To determine which mode (pictures vs. manual signs) resulted in more efficient learning of independent requests, individual graphic displays of percent of independent requests using picture or signs during each session were analyzed (see Figures 1 and 2). Visual inspection evaluated the degree of separation in data paths between baseline and intervention, and between the two intervention conditions for each participant.

As seen in Figure 1, Hannah exhibited zero-level responding during baseline, but began to independently request items using pictures in Sessions 8 and 11. Then, beginning with

Session 16 and continuing for the remainder of the study, there was a clear separation in data paths, with percent of independent requests using pictures increasing to near 50%, while requests using manual sign remained at zero.

Mandy's graph, also in Figure 1, showed zero-level responding during baseline. The introduction of each intervention was associated with an immediate increase in level and trend. Mandy's levels of independent requests reached 100% at Session 6 using pictures and at Session 8 using manual signs. By Session 11, Mandy achieved 100% independent requests in both interventions, and this level was maintained for the duration of the study.

As indicated in Figure 2, Nelly had zero-level responding during the baseline phase. Nelly's percent of independent requests increased beginning in Session 6 (manual sign) and Session 7 (pictures). However, Nelly's percent of independent requests initially increased faster with picture intervention until Session 19 where overall levels were similar for both interventions for the duration of the study. Analysis of individual items shows general consistency between picture items. However, one manual sign item showed the highest independence overall while the remaining two items were lower compared to picture items.

Figure 2 also shows that Liam had zero-level responding for both interventions during baseline and the first six sessions of the intervention phase. A separation in data paths began with Session 10, with picture intervention showing an increasing trend and manual sign intervention remaining at zero throughout intervention. During picture intervention, there was a dramatic drop in the percent of independent requests in Session 17 following extended interruptions in intervention due to a holiday break, student absences, and snow days. Following modifications to the intervention during Session 22, Liam's percent of independent requests using pictures increased to 100% for two sessions, dropping only slightly in Session 24.

Number of trials/sessions to mastery. The number of trials and sessions to mastery for independent requests for each item and participant are displayed in Table 3. Mastery was defined as making independent requests on at least 80% of trials over three consecutive sessions. Hannah was unable to demonstrate mastery of requests in either intervention. Mandy mastered requests with pictures and signs in an equal number of trials, but with fewer sessions in

picture intervention. Nelly mastered one item with manual sign requests and no items with picture requests. Liam mastered picture requesting, with modifications for one item, and showed mastery-level performance for the remaining two items before the study ended.

***RQ_{1b}**: Using a single communication instruction method, which mode (pictures vs. manual signs) results in more efficient learning, as measured by the number of sessions and trials to mastery for discriminated requests?*

Table 4 shows that most items were mastered with the exception of one item in picture and manual sign intervention for Nelly. For discriminated requests using manual signs, Hannah mastered requests across items with fewer sessions and trials, Mandy mastered requests across items with slightly fewer trials, and Nelly mastered requests with slightly fewer sessions and trials to mastery. Liam was not assessed with discrimination probes because he had a history of frustration around choices and denied access to tangibles.

Research Question 2

***RQ_{2a}**: Using a single communication instruction method, which mode (pictures vs. manual sign) results in more effective learning as measured by number of items meeting mastery criteria for independence, percent of nonoverlapping data (PND) from baseline to intervention, and average percent of items requested independently for each intervention?*

Mastery of independent Requests

Looking at Figure 3, Liam (Participant 1) mastered one item with pictures and Nelly (Participant 4) mastered one item with manual sign. Mandy (Participant 3) mastered all requests with pictures and manual sign while Hannah (Participant 2) did not attain mastery in either intervention.

PND for Interventions

Table 5 shows PND values to be moderately effective for Hannah with picture requests but not effective with manual sign requests. For Mandy, both picture and manual sign intervention were associated with PND values in the highly effective range. PND values for Nelly were in the moderately effective range for both picture and manual sign intervention. For Liam,

PND values were in the moderately effective range for picture intervention but not effective for manual sign intervention.

Percent Independence

Looking at Figure 4, Hannah's independence was higher with picture intervention as she did not demonstrate independence with manual sign intervention. For Mandy, high levels of independence occurred with both picture and manual sign intervention. A slightly higher overall level of independence occurred with picture intervention (+7.0%; 95.1% compared to 88.0%). Nelly showed higher independence with picture intervention (+15.1%; 42.5% compared to 27.4%) although she was most independent requesting cracker with manual sign intervention. Liam was more independent with picture intervention compared to sign intervention (+34.4%).

***RQ_{2b}**: Using a single communication instruction method, which mode (pictures vs. manual signs) results in more effective learning as measured by number of items meeting mastery criteria for discrimination, and average percent of items discriminated for each intervention?*

Figure 5 shows there were no differences between mastery of discriminated requests for participants but that most items did meet mastery criteria.

Looking at Figure 6, Hannah's discriminated requests were slightly above 50% chance levels and higher for manual sign items compared to picture items (+6.2%). Mandy was highly accurate with discriminated requests and no differences between picture and manual sign intervention were evident. For Nelly, discriminated requests were higher with manual sign items compared to picture items (+10.1%). Liam was not assessed for discriminated requests.

Research Question 3

***RQ₃**: Using a single communication instruction method, which mode (pictures vs. manual signs) results in more vocalizations as measured by percent of trials in which vocalizations occur?*

Nelly frequently vocalized during manual sign intervention (30.7%) and rarely, along with Hannah and Liam, vocalized during picture intervention (0.2 - 0.8%)

Looking at Figure 7, Hannah did vocalize once during picture intervention but not during manual sign intervention. Mandy showed the largest percent of vocalizations across participants

and requested more with manual signs (31%) than pictures (1%). In Figure 8, Nelly did not vocalize during picture or manual sign intervention. Liam rarely requested with vocalizations (three trials with picture intervention and two trials with manual sign intervention) and did not show substantial effects or differences between picture and manual sign intervention.

Research Question 4

***R_{Q4}:** Using a single communication instruction method, which mode (pictures vs. manual signs) results in more generalization as measured by the percent of probes in which spontaneous requests, communication with new people, and communication in novel settings are observed?*

Figure 9 shows the frequency of items requested when items were not present (spontaneous), with new people (person generalization), and in novel settings (setting generalization). In addition to visual inspection of the graphs, anecdotal information collected during weekly teacher interviews is presented.

During initial probes following the start of intervention for all four participants, requests were not observed to occur with items out of sight, with new people, or in novel settings. During the study, Liam and Hannah did not attain mastery criteria, so no follow-up generalization probes were conducted. For Mandy and Nelly, a total of three sets of generalization probes were conducted, two following mastery of the first item in either intervention.

Hannah

Hannah did not demonstrate generalization when initially probed and did not reach mastery for any items during intervention. Over the course of the study, the intervention team provided anecdotal information that Hannah generally understood the expectations for requesting with both pictures and manual signs. Although Hannah had difficulty forming manual signs, she frequently gave her arms to the prompter for assistance but prompt fading was not successful throughout the study.

Mandy

As shown in Figure 9, although Mandy did not request items during baseline and the first set of generalization probes, follow-up probes showed some generalization effects. Of the three picture items, Mandy did not make requests on the second set of probes but she spontaneously

requested all three items from a different person and in a different setting on the third set of probes. Of the three manual sign items, Mandy independently requested all three items on the second set of probes and two of three items on the third set of probes. Mandy did not spontaneously request using manual signs.

Nelly

Figure 10 indicates Nelly did not request items in either intervention spontaneously (without items present). Of the three picture items, Nelly spontaneously requested all three items from a different person and in a different setting on the second set of probes but only requested one item from a different person and in a different setting on the third set of probes. Of the three manual sign items, Nelly requested two of the three items from a different person and in a different setting on the second set of probes and all three items from a different person and in a different setting on the third set of probes. Overall, Nelly made five manual sign requests and four picture requests during generalization probes and she did not spontaneously request using manual signs. Anecdotal intervention team reports did not indicate use of picture requests outside of intervention situations. Nelly began to independently request “cracker” before it was presented showing independence and fluency with the manual sign request.

Liam

Over the course of the study, the intervention team provided anecdotal information about Liam and that he did have communicative intent. This information and observations by the investigator noted that Liam frequently gave his arms to the prompter for assistance but did not respond well to prompt fading. Initial reports noted that Liam continued to lead them by hand to request items in the classroom even when pictures were posted in various areas as part of the classroom. Over a two-month span during intervention, Liam spontaneously opened his book and looked through the pictures on four separate occasions prior to the presentation of items. On two of these occasions, he spontaneously requested “puzzle” and “movie”. These observations would be consistent with generalization probes for spontaneous requests specific to the fact that items were not in view when they were requested. Finally, the intervention team consistently reported collateral progress in attention to task, cooperation with instruction, decreases in the

frequency and magnitude of behaviors associated with frustration, general approach to and endurance with activities at the group table, decreased challenging behavior during transitions and across the day, and more appropriate play.

Social Validity

All intervention teams completed the social validity questionnaire together, providing one set of feedback with the exception of Nelly's team. Information from Nelly's team was combined for consistency in reporting. All intervention teams (100%) indicated they were able to implement the interventions successfully, that they received adequate support on a weekly basis with availability by email or phone for additional support, and would participate in this study again.

Intervention teams indicated at least one intervention was effective (100%) and that an optimal strategy was identified (75%) or that both strategies were equally effective (25%). One participant was reported to appear to prefer one strategy over the other with additional observations on specific item preferences. Hannah and Liam were reported to use the optimal strategy after the study ended. Informal follow-up one year later noted observations that Liam has established a strong communication repertoire and Hannah continues to struggle with independent requests requiring discrimination but is successful with Phase I of the PECS across multiple items and activities during the school day.

All intervention teams indicated professional benefits to implementation of these procedures. Specific comments included that the study opened eyes to using a form of communication based on child preference rather than adult preference (50%), provided good reinforcement and training in ABA (50%), developed skills that could be used in the future (50%), provided good training in working with nonverbal students (25%), enabled staff to learn more about her student (25%), and surprised staff to see how much the student remembered and spontaneously requested during the study (25%).

Specific things intervention teams liked included a general appreciation of helping students (100%), seeing progress of the student each day (75%), development of cooperation during procedures (50%), and seeing overall progress in other skills such as transitioning, sitting, attending, decreased aggression, and appropriate play (25%).

Specific things intervention teams disliked included occasional difficulty scheduling two sessions each day (50%), occasional disinterest of student to request the same items over the course of the study (50%), a bit time consuming (25%), and increased trips to the bathroom due to the use of edibles (25%).

Suggestions for improvements included consideration of changing items rather than using them for the entire 8 weeks (25%), conducting another preference assessment when motivation drops (25%), and reducing the length of intervention sessions to prevent occasional satiation (25%).

CHAPTER 5

DISCUSSION

Learning to communicate effectively is an important goal of education for young students with ASD and ID (National Research Council, 2001; Palmer & Wehmeyer, 2003). While research has shown several AAC strategies can be effective (Ganz et al., 2012; Mirenda, 2003; Schlosser & Sigafoos, 2006; Tincani and Devis, 2011), no one specific AAC strategy (e.g., manual sign, pictures) has been shown to be universally better than others (Schlosser & Sigafoos, 2006; Tincani, 2004). As a result, practitioners are left with little direction for making empirically-based decisions about what strategy to use with particular students (Goldstein, 2002; Schlosser & Sigafoos, 2006; Tincani, 2004). The purpose of this investigation was to provide a method for teachers in public education settings to identify an optimal modality for students with ASD and/or ID who have limited or no functional communication by comparing the relative effectiveness of using pictures and manual signs to request highly preferred items. Following is a discussion of the findings related to each of the research questions, the potential strengths and limitations of the investigation, and the implications of the findings for future research and practice.

Research Question 1

RQ1a: Using a single communication instruction method, which mode (pictures vs. manual signs) results in more efficient learning, as measured by the percent of independent requests per session and the number of trials to mastery for independent requests.

It was hypothesized there would be no difference between interventions across participants, but that differences would be idiosyncratic for individual participants. These results provided partial support for the hypothesis in terms of mixed results across participants and even within participants at the individual item level. However, there appeared to be a mild advantage for picture intervention across participants. It should be noted that most comparison studies did not produce mastery performance for all participants (dissertation study by Anderson, 2001; Gregory et al., 2009; Tincani, 2004) and similar shortcomings occurred with mastery to Phase III (Angermeier, 2008; Ganz et al., 2008; Tincani et al., 2006) and reviews have documented less robust effects for individuals with ASD and ID combined (Ganz et al., 2012). Because attainment

of mastery was limited in this study, a greater emphasis was placed upon independent responding in sessions over time. A key advantage of this study is the ability of an alternating treatment design to compare the relative effects of each intervention despite the inability to produce mastery-level responding.

Hannah

Hannah did not show independence with sign requests and showed only partial independence with picture requests. A clear separation in data paths was evident in Figure 1 beginning with session 13, with an increasing trend and change in level that maintained for the remaining 12 sessions until completion of intervention. This information was consistent with low scores on the fine motor imitation assessment prior to intervention, with other research showing an association between low motor skills and limited response to manual sign instruction (Anderson, 2001; Gregory et al., 2009; Seal & Bonvillian, 1997; Tincani, 2004). These data clearly identify pictures as the more efficient modality for Hannah. Input provided by the intervention team on the social validity questionnaire, IEP team and parent feedback concurred with this conclusion and noted that picture intervention was a better option for Hannah.

Anecdotal conversations with the educational team suggested they believed that manual sign acquisition was not feasible for Hannah and that picture intervention was the better option. To further clarify and evaluate this interpretation, modifications were made with manual sign intervention to see if any responding would result. For manual sign intervention, the Giver provided a modeled prompt immediately following Hannah's initiation to attain the corresponding item while the Prompter waited 3 seconds before resuming typical prompting duties. This modification did not elicit independent or partially independent requests for Hannah and provided further support for no effects of manual sign intervention.

Of the four participants, both interventions were the least efficient for Hannah. Several explanations are offered that may partly explain this result. Hannah was the lowest functioning individual based on standardized assessments and was identified as an individual with ASD and ID. In addition, Hannah's baseline phase occurred prior to Thanksgiving and her participation in the study was interrupted by several holiday breaks, snow days, and student and staff absences.

These are typical challenges in the school setting and provided a more representative application for educators than efforts conducted at higher intensities within a clinical setting or by external personnel (e.g., graduate students and investigators). The combination of individual characteristics and interruptions to the course of intervention provided good explanations for the limited effects of intervention with Hannah.

Mandy

Mandy demonstrated zero-level responding during baseline but independent requests reached 100% at Session 6 using pictures and at Session 8 using manual signs (Figure 1). In terms of trials to mastery (Table 3), picture and sign requests were equally efficient. She mastered all items in substantially less time for both interventions as compared with other participants. Furthermore, when compared to other studies reporting trials to mastery, it is rare that mastery is attained in less than 100 instructional trials (Adkins & Axelrod, 2001; Chambers & Rehfeldt, 2003). This finding may partially be explained by her high score on the fine motor imitation assessment, a result that has been hypothesized in prior investigations (Anderson, 2001; Gregory et al., 2009; Tincani, 2004). Based on efficiency of intervention, either mode would be considered optimal for her. Feedback from the intervention team on the social validity questionnaire agreed with this general conclusion.

Nelly

When considering Nelly's independent requests (Figure 2), a slight advantage was evident early on for picture intervention as she began to demonstrate independence two sessions earlier with picture intervention than with manual sign intervention. This initial advantage remained until session 19 and then both interventions were indistinguishable for the last six sessions of intervention. In terms of trials to mastery (Table 3), Nelly was more efficient with manual sign requests based on mastery of one target in 143 trials while mastery was not obtained for any item using pictures. Nelly was reported to request items with manual sign spontaneously or before the next instructional trial started. This occurrence suggests some advantages regarding fluency and independence for one item in manual sign intervention. Altogether, these data would suggest that manual sign was the more efficient intervention for

Nelly. Feedback from the intervention team on the social validity questionnaire supported this conclusion and it was specifically reported that Nelly appeared to prefer to use manual sign and was frequently signing during instruction.

Although Nelly had a low score on the fine motor imitation assessment, she attained mastery for one manual sign item and no picture items. This result would not be anticipated based upon evidence that low fine motor skills may interfere with the ability to acquire manual signs (Anderson, 2001; Gregory et al., 2009; Tincani, 2004). However, it should be noted that the inherent requirement of imitation in the assessment does not directly assess whether or not an individual can perform the motor skill on his/her own. Also, the ability of predicting an individual's response to an intervention based on a fine motor imitation assessment may apply more to procedures that incorporate modeling prompts. Procedures in this study used graduated guidance even though the Giver did demonstrate the manual sign immediately following the request (this was not a prompt but feedback associated with direct rehearsal and used with simultaneous or total communication procedures).

Several points should be made regarding picture requests. First, it is possible that higher responding in picture intervention may be partly explained by the concrete nature and potential cue provided by materials. Second, once an individual learns the motor response to pick up and deliver the icon (approximately equivalent to PECS Phase I), there is a 50% chance that the item available will match the picture selected from a field of two icons. As shown in Figure 2, Nelly's increase from zero-level responding in baseline began on Session 7 and reached 58% by Session 9. These data would suggest Nelly learned the motor response at this point. Beginning with Session 9, responding appears to level out or increase marginally with some variability for the remainder of intervention (range, 39-75%) and this pattern was no different for each of the three picture items. This lack of progress would be consistent with performance based primarily on a guessing strategy. The intervention team reported that Nelly did not always look at the picture field before making her selection. Conversely, the delayed increase in manual sign requests from baseline would more likely be the result of learning specific requests than a

guessing strategy. Ultimately, Nelly's data would project that, unless discrimination of pictures is learned, manual sign would be the better option.

Performance in sign intervention showed a stark contrast between the one item mastered and the other two items, which effectively bogged down learning efficiency when calculated across targets. This discrepancy among manual sign items may be the result of different levels of response effort, motivation, or a combination of both. Motivation was generally assumed as the decision to instruct an item was based on the participant's choice and the delivery of prompts to request subsequent items only followed student initiations to attain these items. What is interesting is that independent manual sign requests for ball ranged from 0% - 80% and ball was the least requested item during manual sign intervention. This would appear to reflect inconsistent motivation for requesting the ball because a level of 80% independence is high and unlikely to occur as the result of chance. Another explanation may align with prior observations (Anderson, 2001), that the response effort may have ultimately outweighed the motivation for certain items at particular times. Perhaps the most plausible explanation is that mastery of a single item in manual sign intervention ("cracker") may have occurred as a result of high motivation for animal cracker (this was the second highest preference with the highest preference assigned to pictures) or possibly the inherent ability to produce the motor sequence required for that item only.

Liam

Liam did not show independence with sign requests and showed only partial independence with picture requests. In terms of trials to mastery, Liam was more efficient with modified picture requests. A clear separation in data paths began on session 7 with an increasing trend that was temporarily offset by schedule interruptions, but remained at a higher level for picture requests throughout the study. A clear difference between interventions was demonstrated, showing the practical significance of this study in identifying pictures as the more efficient modality for Liam. This result was consistent with feedback from the intervention team on the social validity questionnaire indicating that pictures were the optimal mode for Liam.

Modifications were made to both interventions because Liam had approached mastery with picture requests earlier in the study and, although he was not responding to manual sign intervention, he did understand that a motor movement was needed as he would frequently reach back to solicit the prompt for manual sign request. For manual sign intervention, the Giver provided a modeled prompt immediately following Liam's initiation to attain the corresponding item while the Prompter waited 3 seconds before resuming typical prompting duties. For picture intervention with Liam, all three pictures representing preferred items were available and could be requested. With these modifications, Liam immediately exhibited 100% independence with picture requests but continued to lack independence with manual sign requests. This explanation is most likely due to the less adult-directed nature of the modification in which Liam was allowed to request any item from the field of three preferred items rather than only the item just validated. This is supported by observations that Liam was content and did not show signs of disapproval when receiving the item he requested. However, this modification allowed for the possibility that Liam was not discriminating between pictures to request specific items (performance equivalent to PECS Phase I), possibly due to chance correspondence or temporary satisfaction with any of the preferred items

Summary

Together, these results are consistent with prior research (Adkins & Axelrod, 2001; Anderson, 2001; Chambers & Rehfeldt, 2003) and showed some level of advantage with picture requests across participants in terms of independence per session (Hannah and Liam). For both of these participants, educators were able to determine an optimal communication mode. The results from this study replicate prior efforts (Adkins & Axelrod, 2001; Anderson, 2001; Chambers & Rehfeldt, 2003) in isolating the different intervention effects to the modality of communication by controlling for different instructional methods. These results also extend the literature by demonstrating similar effects with different intervention procedures feasible for use within the school setting by teachers and paraprofessionals.

RQ_{1b}: Using a single communication instruction method, which mode (pictures vs. manual signs) results in more efficient learning, as measured by the number of sessions and trials to mastery for discriminated requests?

It was hypothesized that there would be no difference between interventions across participants, but that differences would be idiosyncratic for individual participants regarding the efficiency of learning discriminated requests. All participants learned to discriminate manual sign requests (Liam was not taught discrimination) in either fewer trials (5.5-64.3) or sessions to mastery across items. Manual sign intervention was substantially more efficient (308%) regarding discriminated requests for Hannah. These data do not provide support for the hypothesis of no differences but suggest a slight advantage in efficiency for manual sign instruction in the acquisition of discriminated requests. These data should be cautiously interpreted based on the limited number of probes they are based upon for each participant and intervention (13-23) and the influence of chance on a task requiring selection from a field of two items.

Nevertheless, this result would be consistent with theory comparing AAC options based on their topography and requirements of the learner. Two specific differences between these interventions can offer explanation for potential differences in discrimination learning. First, the topographical correspondence between each item and request form is unique for manual signs but not for pictures (Michaels, 1985). Therefore, it may be easier to guess or overlook the specific association between a picture and its referent because each picture request looks the same (the delivery of a picture that was previously scanned and discriminated). This is unlikely to occur with a manual sign that requires the production of a topographically unique formation in relation to its referent. Second, there are fewer stimuli present between the initial motivation to request an item and the delivery of the desired item with manual sign intervention compared to picture intervention. For picture requests, an extra step is required in which the participant must divert their attention to the picture array, scan, and select the corresponding picture. It is possible that these additional steps may ultimately dilute the strength of association between the desire for an item and the receipt of the item. Also, these intervening steps may result in differences

between interventions regarding response effort and the immediate and specific effects of reinforcement (i.e., the time and effort between the desire for an item and the receipt of the item). The PECS protocol (Bondy & Frost, 2002) does address this step as a modification by providing general verbal praise or feedback when the student selects the correct picture icon; however this application has not been discussed in the literature to date (Sigafoos, Ganz, O'Reilly, Lancioni & Schlosser, 2007). Moreover, if the "intended" item was not the actual item requested (i.e., a student wants pretzel but selects and delivers the picture of cracker), additional confusion may occur along with extinction of the request. This latter effect is common in practice when teaching manual signs, often referred to as scrolling. The hypothesis that manual sign intervention may produce better discrimination has not been directly explored in the research to date.

In summary, the current results are not consistent with research reporting advantages of picture intervention over manual sign intervention when discrimination was a component skill of the intervention (Anderson, 2001; Chambers & Rehfeldt, 2003). This may be the result of the looking at requests and discrimination separately in this study. One hypothesis for this potential result would be that advantages in acquisition of requests with picture intervention are stronger than advantages of acquisition of discrimination with manual sign intervention. There is support for this as Hannah more efficiently acquired picture requests and manual sign discrimination and showed an overall advantage with picture items (Liam was the only other participant more efficient with pictures but he was not taught discrimination). This finding of differences between interventions favoring manual sign in efficiency of discrimination, although tentative and not robust, has not been reported in the literature to date. This study offers the first investigation of this relationship using a single methodology feasible for implementation within the school setting by teachers and paraprofessionals.

Research Question 2

***RQ_{2a}:** Using a single communication instruction method, which mode (pictures vs. manual sign) results in more effective learning as measured by number of items meeting mastery criteria for independence, percent of nonoverlapping data (PND) from baseline to intervention, and average percent of items requested independently for each intervention?*

It was hypothesized there would be no difference in intervention effectiveness across participants, but that differences would be idiosyncratic for individual participants. Overall, mastery criteria (Figure 3) and PND (Table 5) suggest mixed results across participants while all participants exhibited a higher average percent of independent requests on items across sessions during picture intervention compared to manual sign intervention (Figure 4). These data provide partial support for the hypothesis of no differences across participants and idiosyncratic effects for individual participants.

Hannah

Based on mastery criteria, Hannah did not achieve mastery in either intervention, although picture intervention was more effective regarding PND and the average percent of independent requests overall. Hannah did not respond to manual sign intervention, even with brief modifications. The average percent of independence across sessions was 19.2% for picture intervention and Hannah was unable to display consistent independent responding in either intervention. Hannah was developmentally low functioning, possessed a short attention span, and was easily distracted. She appeared to inconsistently understand the purpose of exchanging a picture icon for a desired item and was reported to appear to attempt a gesture on a couple trials in manual sign intervention. This study still resulted in clear differences between interventions and the practical significance of identifying an optimal communication modality for Hannah. As a result, the intervention team could recommend using pictures and providing a higher frequency and concentration of intervention for Hannah across the daily routine.

It should be noted that Hannah's fine motor imitation score was low and similar to Nelly's and Liam's scores. However, Hannah was the only student that could not consistently select and deliver icons. This result was not anticipated and highlights the current need for more sensitive assessment tools to guide the use of intervention with AAC options. Perhaps Hannah's relatively low functioning and multiple disabilities including ASD, ID, and hyperactivity provided the best explanation for her difficulty in acquiring requesting skills overall. In fact, similar difficulties were reported by Ganz et al (2008) with a participant sharing highly similar characteristics to Hannah.

Mandy

Based on mastery criteria and PND, Mandy was equally effective with both pictures and manual signs. Mandy exhibited a slightly higher average percent of independent requests overall with picture training (95.1%) compared to manual sign intervention (88.0%). A clear advantage of one intervention over the other could not be systematically determined for Mandy over the course of intervention. Fortunately, she responded well to both interventions and her teachers were effectively able to identify two optimal modes of communication for Mandy based on these results.

Nelly

Based on mastery criteria, Nelly was more effective requesting with manual sign. Although PND suggested no differences between interventions, Nelly showed higher average levels of independence across all targets in picture intervention (42.47%) compared to manual sign intervention (27.43%). The decision of an optimal mode for Nelly is not initially clear but several points and suggestions may be helpful in making a determination.

First, mastery was achieved with manual sign and the intervention team reported that Nelly performed manual sign requests before the next instructional trial was initiated on several occasions with manual sign intervention, including a couple sign requests for a different item than was being instructed at the time. Second, the advantage in overall independent requests for pictures should be interpreted with caution regarding chance as previously discussed. Following the course of progress by Nelly, response to picture intervention appeared to plateau around chance levels while she showed ongoing progress with manual sign intervention.

Session data showed that this item was the most independently requested across items and interventions for Nelly. The preference assessment ranked this item as the second highest preferred item. Interestingly, the sign for animal cracker is not considered easy (i.e., arms crossed but with the left arm raised vertically with the elbow touching the right hand made into a fist), especially compared to goldfish (i.e., right hand extending as if to shake a hand but moving to imitate the tail of a fish), and it is unlikely that this manual sign was taught previously or outside of the study.

An additional discussion is warranted for cases in which interpretation is not entirely clear in delineating among intervention effectiveness and when “guessing” is suspected with picture training. Systematically planning the location of picture icons in the field, increasing the field beyond two icons, modifying both intervention to include a model of the request by the Giver (Giver performs the manual sign or displays a matching picture icon), or potentially increasing the concentration or duration of interventions to eventuate differences between interventions.

Liam

Based on mastery criteria, PND, and the average percent of independence across sessions, data consistently showed that Liam was more effective requesting with pictures and did not respond to manual sign intervention or modifications to manual sign intervention. For Liam, this study was successful in demonstrating clear differences between interventions and the practical significance of identifying an optimal communication modality.

It should be noted that Liam began to respond well to picture intervention in sessions 12-16, approaching mastery-level responding. Unfortunate timing led to the winter break and what appears to be substantial regression in skills in which Liam never did return to the same level of responding despite increases in trend. Teacher reports indicated temporary regression with behaviors as well at this time. After the second break and greater regression, modifications were made to both picture and manual sign intervention. Mastery in picture intervention was obtained immediately following modifications to the intervention and that these modifications were based on specific observations that Liam would occasionally open his book and request prior to instruction and sometimes when items were not in view. A similar understanding of communicative intent was noted in manual sign intervention in which Liam understood the basic concept that a gesture is performed prior to getting a desired item/activity. He began relaxing his hands and even holding them out for the Prompter after several sessions.

Liam lacked independence with manual signs and this may have been linked to poor fine motor imitation skills and possibly the more abstract nature of manual signs compared to picture requests. Although modifications to manual sign intervention were limited to three sessions, he did not show the ability to imitate the models provided and this performance was consistent with

his low fine motor imitation skills prior to intervention. Explanation for why responding did not reach mastery levels with initial picture intervention may be partly due to the originally modified procedures where a choice between two actual items was avoided (validations) due to prior problem behaviors when asked to make choices between preferred stimuli. It is possible that Liam was aware of the other items and preferred to have an item other than the item “currently available”. If Liam could discriminate among pictures and was allowed to request any of the preferred items at any time, the subsequent results would have been predicted. Although mastery was reported with modifications to picture intervention, some caution is warranted. This level of responding may be parallel to Phase I performance in PECS where the basic “exchange” is understood but specific discrimination skills or understanding of picture icons representing specific items may not be present until Phase III. One cannot definitively say that Liam was discriminating requests during this time, especially because modifications precluded the use of discrimination probes due to Liam’s behavioral history.

Summary

All four participants averaged higher levels of independence across sessions with picture items, PND data for Liam and Hannah indicated that picture intervention was more effective than manual sign, and mastery of items indicated that picture intervention was more effective for Liam. These results are consistent with previous research (Adkins & Axelrod, 2001; Anderson, 2001; Chambers & Rehfeldt, 2003) and showed broader effects on the acquisition of picture requests across a range of diverse participants. Two of three participants with low motor imitation skills did not respond well to manual sign intervention (Hannah and Liam), a finding that is consistent with research suggesting differential performance based on fine motor imitation skills (Anderson, 2001; Gregory et al., 2009; Seal & Bonvillian, 1997; Tincani, 2004). However, there were some mixed results also reported in the literature (Tincani, 2004). Regarding mastery, there were no differences between interventions for Hannah and Mandy while Nelly was more effective with manual sign requests. There were also no differences between interventions on PND for Mandy and Nelly.

The consistency between results of this study with prior research, in addition to high intervention integrity, adds confidence that such efforts can be done by educators within the school setting using existing resources. This study specifically replicates these effects when attempts were made to control methodological differences between communication modalities (Adkins & Axelrod, 2001; Anderson, 2001; Chambers & Rehfeldt, 2003) and extends the literature by demonstrating these results with a more concise methodology implemented within a school setting by teachers and paraprofessionals.

Research Question 2b: Using a single communication instruction method, which mode (pictures vs. manual signs) results in more effective learning as measured by number of items meeting mastery criteria for discrimination and the average percent of discriminated requests across sessions?

It was hypothesized that there would be no difference in the number of items mastered between interventions across participants, but that differences would be idiosyncratic for individual participants. This hypothesis partially supported (Figure 5) by no differences between interventions in the number of items mastered for the three participants who were taught discrimination but some differences occurred in the percent of correctly discriminated items across sessions (Figure 6) favoring manual sign for Hannah (+6.2%) and Nelly (+10.1%). The same caution is recommended in interpreting discrimination probe data based on a limited sample (13-23). This mild difference in effectiveness of discrimination with manual sign, combined with a small difference in the efficiency of discrimination with manual sign, provides a case for further questioning in whether these differences are practically meaningful and truly reflect differences in topography and learner expectations between picture and manual sign intervention.

In summary, this study offers the first investigation comparing the relative acquisition of discrimination skills based on the mode of communication and suggests that there may be some advantages with manual sign intervention. These data are limited and highlight the need for further evaluation involving more detailed measures. The general trend for higher independence with picture requests (all four participants) and higher discrimination with manual sign requests

(two of three participants receiving discrimination instruction) may reflect the inherent qualities of each mode of communication. Pictures provide concrete opportunities to guess when requesting compared to manual signs and may have an advantage with discrimination probes if the individual can visually match the picture to the item. However, the extra step of selecting and delivering pictures requires the individual to divert visual attention from the actual item and may interfere with or distract the individual from then taking the item requested. For manual sign requests, there are fewer steps and no specific demands to distract visual focus on the desired item. It is conceivable that the student could see the item while performing the manual sign request and then immediately choose the corresponding item from the two items offered. Caution is indicated in drawing conclusions from these data because discrimination was probed once at the start of intervention for each item and there are a limited number of data to report.

Research Question 3

R_{Q3}: Using a single communication instruction method, which mode (pictures vs. manual signs) results in more vocalizations as measured by percent of trials in which vocalizations occur?

It was hypothesized that communication with manual signs would result in higher vocalization acquisition rates as compared to pictures. Limited evidence suggests that manual sign intervention was associated with more vocalizations for one participant and that little or no vocalizations were observed for the other three participants (Figures 7 & 8). Specifically, during manual sign intervention, Mandy vocalized on 30.7% of trials and Liam vocalized on 0.4% of trials. During picture intervention, Hannah, Mandy, and Liam rarely vocalized (0.2 - 0.8% of trials). Nelly did not vocalize during either intervention. These results provide some support for the hypothesis of higher vocalizations during manual sign intervention.

In summary, this finding is consistent with previous research and showed higher levels of vocalization with manual sign intervention compared to picture intervention (Anderson, 2001; Tincani, 2004; Chambers & Rehfeldt, 2003). Similarly, although vocal imitation skills were not formally assessed, knowledge of Mandy's ability to vocalize (specifically vocal imitation) was common and Mandy was relatively higher in vocalizations compared to Liam while Hannah and Nelly were rarely observed or reported to vocalize. It is interesting that there was such a contrast

in vocalizations between interventions when the rates of acquisition and independence were fairly similar. This effort extends this effect to a feasible methodology for teachers and paraprofessionals to identify an optimal mode of communication for students with ASD and ID.

Research Question 4

R_{Q4}: Using a single communication instruction method, which mode (pictures vs. manual signs) results in more generalization as measured by the percent of probes in which spontaneous requests, communication with new people, and communication in novel settings are observed?

It was hypothesized there would be no difference in generalization effects between interventions across participants, but that differences would be idiosyncratic for individual participants. Figures 9 and 10 show that Mandy and Nelly more frequently generalized manual sign requests compared to picture requests but only exhibited spontaneous picture requests. These data did not support the hypothesis for no differences across participants or for idiosyncratic differences for individual participants. A clear advantage was found with spontaneous requests associated with picture intervention and a mild advantage was shown for the frequency of generalization with new persons and in new settings associated with manual sign intervention. Unfortunately, these data represent a limited sample and cannot be interpreted to have practical significance.

Anecdotal intervention team reports did not indicate use of picture requests outside of intervention situations or generalization probes for Hannah, Mandy, and Nelly. Nelly began to independently request “cracker” before it was presented and showed independence and fluency with the manual sign request, but she was unable to do so outside of the training context when probed for generalization.

Over a two-month span during intervention, Liam spontaneously opened his book and look through the pictures on four separate occasions prior to the presentation of items. On two of these occasions, he spontaneously requested “puzzle” and “movie”. These observations would be consistent with generalization probes for spontaneous requests specific to the fact that items were not in view when they were requested. However, formal generalization was not probed because mastery was not attained until the conclusion of the study.

In summary, these results showed a mild advantage for manual sign intervention and stand in contrast to idiosyncratic effects found in some investigations (Anderson, 2001; Tincani, 2004) as well as other findings of better generalization with picture requests (Adkins & Axelrod, 2001; Chambers & Rehfeldt, 2003). Mandy and Nelly did exhibit better spontaneous requests with the PECS compared to manual sign intervention. This finding is consistent with other research (Adkins & Axelrod, 2001; Chambers & Rehfeldt, 2003) and prior discussions suggesting that the materials associated with picture intervention may potentially cue responding for participants when other aspects of the intervention environment have been changed or eliminated (Anderson, 2001; Tincani, 2004).

Social Validity

General effectiveness of procedures to identify an optimal mode of communication was confirmed by feedback and validated the primary purpose of this study. All intervention teams indicated at least one intervention was effective (100%) and that an optimal strategy was identified (75%) or that both strategies were equally effective (25%). Intervention teams also reported seeing progress from day to day, increased cooperativeness with the instructional process, and even collateral changes in behavior related to aggression, transitions, engagement, and appropriate play. Hannah and Liam were reported to use the optimal strategy after the study ended by intervention teams and this was observed by the investigator one year later. Liam has established a strong communication repertoire one year later and uses basic vocal utterances, text, and pictures to communicate his wants and needs and to share information with staff (e.g., television program schedules). Hannah is successful with Phase I of the PECS and will spontaneously or independently request a variety of preferred items across activities in the school day with a field of one but continues to struggle with discriminated requests and larger fields of pictures. Although Nelly's progress was not outstanding for either intervention, she mastered one manual sign item and it appeared that manual signs were emerging as the better modality. Unfortunately, school-based staff decided to use a picture-based strategy the following school year based primarily on professional preferences. This example, although ironic, reiterates the

rationale underlying this investigation. No follow up information was available for Mandy, who reportedly moved out of the district the school year following her participation in this study.

General support was provided for the feasibility of the procedures within the education setting. All intervention teams (100%) indicated they were able to implement the interventions successfully, that they received adequate support on a weekly basis with availability by email or phone for additional support, and would participate in this study again. All intervention teams indicated professional benefits to participation that included knowledge of using motivation to deliver communication instruction, learning to use reinforcement and basic ABA principles, an learning how to work with nonverbal students. Some limitations were reported including difficulty scheduling two intervention sessions each day, and maintaining student motivation for items over the course of intervention. Specific things intervention teams liked included a general appreciation of helping students (100%), seeing progress of the student each day (75%), development of cooperation during procedures (50%), and seeing overall progress in other skills such as transitioning, sitting, attending, decreased aggression, and appropriate play (25%).

Potential Strengths

There are several potential strengths of the current investigation. First, the primary purpose of this study was achieved in providing a method for teachers and paraprofessionals to identify an optimal and early mode of communication for students with ASD and ID by comparing the relative effectiveness of using pictures and manual signs to request highly preferred items. Differential intervention effects were clearly demonstrated for two participants, mixed for one participant, and equally productive for another participant. Three of four intervention teams reported that an optimal mode of communication was identified.

Second, teachers and paraprofessional were successful in implementing two interventions at the same time to produce positive effects for each participant. High levels of intervention integrity, acceptable levels of IOA, and notable changes in responding following the introduction of at least one intervention were observed for all four participants in this study. This effect was evident across four different intervention teams, districts, and participants, providing a degree of generalizability through replication.

Third, this study offers a method that is more concise than other AAC options because it uses the same intervention procedures for both pictures and manual signs. Approximately two hours of training with weekly consultation visits was required for each of the four intervention teams. In contrast, some AAC strategies employ a complicated set of procedures requiring two days of training (PECS). Also, research has offered different procedures for both picture training and manual sign training, creating additional challenges for training and implementing two substantially different interventions.

Fourth, this study replicates limited investigations that have focused in on a direct comparison between communication modalities for teaching requesting skills using equitable methodology (Adkins & Axelrod, 2001; Anderson, 2001; Chambers & Rehfeldt, 2003; Gregory, DeLeon et al., 2009) within a public school setting (Adkins & Axelrod, 2001; Tincani, 2004). Replication of particular outcomes include better overall independence and spontaneous requesting with picture training (Adkins & Axelrod, 2001; Anderson, 2001; Chambers & Rehfeldt, 2003; Gregory, DeLeon et al., 2009), better vocalizations with manual sign intervention (Anderson, 2001; Tincani, 2004; Chambers & Rehfeldt, 2003), mixed results regarding individual responsiveness (Tincani, 2004), and partial support (two of three participants in this study) that low motor imitation skills may inhibit the acquisition of manual signs (Anderson, 2001; Gregory, DeLeon, and Richman, 2009; Seal & Bonvillian, 1997; Tincani, 2004).

Fifth, this study extends the literature in several ways. It provides a demonstration that teachers and paraprofessionals can effectively implement a systematic comparison of AAC strategies to identify an optimal mode of communication for students with ASD and ID. Also, this study looks specifically at the relationship between the acquisition of discrimination skills and the mode of communication. Most research does not isolate the skill of discrimination but rather assumes or embeds it within the instructional process (e.g., PECS Phase III) by using a single method to teach picture and manual sign requests. This raises the potential importance of looking more closely at the skill of discrimination when evaluating or comparing various AAC strategies.

Sixth, intervention teams reported a variety of professional benefits from learning to implement procedures during this study. Specific comments included that the study opened eyes to using a form of communication based on child preferences, provided good training in ABA and working with nonverbal students, enabled staff to learn more about their students and seeing progress each day, and collateral benefits in cooperation and other behaviors (transitioning, sitting, attending, decreased aggression, and appropriate play).

Finally, and perhaps most importantly, this study provides a connection between research and practice by providing a feasible, concise, and empirically-based methodology for teachers and paraprofessionals to implement when seeking an optimal mode of communication for students with ASD and ID. Social validity indicated confidence that intervention teams were successfully implementing procedures as trained. This effect is remarkable given the limitations present when relying on natural resources within the school setting and dealing with common barriers related to scheduling, staffing, and absences.

Potential Limitations

There are several limitations of this study. First, this study did not demonstrate strong intervention effects across participants. In terms of mastery, one participant did not respond to either intervention, one participant responded well to both interventions, and two participants mastered a single item in one intervention. More robust findings have been reported by other comparison studies (Adkins & Axelrod, 2001; Anderson, 2001; Chambers & Rehfeldt, 2003; Gregory et al., 2009). These results may be due to several explanations. One explanation may include scheduling difficulties and intervention concentration specific to Liam and Hannah, a natural consequence of schools and staffing that were not indicated as factors in other published studies. Another explanation may relate to a relatively low number of instructional trials for items (range of 97-228). Other comparison studies report mastery, on average, between 200 and 300 trials (range of 21-460). A final limitation that may have affected skill acquisition was the baseline procedure used. Students were given access to items during baseline (delayed) and once immediately prior to instruction (validation trial) effectively for reaching or showing other signs of motivation for the item that did not include the requesting skills that were taught during

intervention. It is possible that this may have interfered with learning to request with pictures or manual signs if students thought they could ultimately access preferred items with other behaviors.

Second, there are several limitations related to the design of this study. Some limitations associated with an alternating treatment design could not be controlled for in this study. Dilution of treatment was a factor that may have prevented mastery-level acquisition of requests in both treatments. Fortunately, this limitation did not substantially impact the outcomes of this study specific to delineating differences between interventions. Multiple treatment interference cannot be ruled out completely as both interventions were conducted daily and sometimes within two hours of each other, allowing for possible carryover effects, especially regarding discriminated requests. Finally, determination of a functional relationship between the independent variable and dependent variable is relatively weak with the ATD because two functional relationships are being compared. Similarly, replication of a consistent relationship between both intervention and measured outcomes was limited as idiosyncratic effects were anticipated. However, for Hannah and Liam, experimental control was stronger because their responses varied consistently with the alternating interventions and there was no overlap between interventions.

A third limitation of this study was allowing too much time before modifying interventions with Liam and Hannah. The quick success achieved by Liam when picture intervention was modified suggests that expedited modifications may have also been successful and would have enabled measurement of generalization and possible exploration of discrimination skills for Liam. In addition, earlier implementation of a modeling prompt or perhaps further modification to manual signs may have led to different results for Liam and Hannah with manual sign requests.

Fourth, the methodology used in this study, although incorporating established best-practice elements, is a somewhat unique training method that deviates from the PECS protocol and mand-model training to provide a single method. This study employed a graduated guidance procedure fading to lesser prompts to minimize errors and maintain student responding through frequent and immediate reinforcement. This more aligned with the PECS protocol (Bondy &

Frost, 2003) but also deviated significantly by embedding discrimination training at the start and not using visual distracters as stimuli to teach discrimination.

At the same time, procedures deviated from mand-model strategies that incorporate a time delay and modeling prompt by waiting for student initiation and separating the prompt from access to preferred items by having distinct roles for each of the two adults conducting the intervention. In fact, this strategy is similar to that used by Tincani (2004) adapted from the PECS when prompt dependency with manual signs was observed in response to the modeling procedure. However, frequent observations by the investigator and intervention teams noted that students sometimes reached out their arms or relaxed their hands in an effort to solicit prompts. Although this showed a basic understanding of the need to request a desired item and some degree of initiation, this is also another form of prompt dependence. Conversely related to the efforts of Tincani, switching from physical prompts to a modeled prompt may have been a desirable modification and potentially have led to more independent responding.

Fifth, although deprivation of intervention items in the home setting was discussed and encouraged, this could not be controlled and was not mandated. It is possible that satiation and treatment interference may have influenced the effects of intervention. The current awareness of the importance of communication and mand training for individuals with ASD and ID makes it probable that most individuals will have been exposed to these interventions prior to inclusion in this study. Several specific efforts were made to gather information about participant history, directly observe and interview participants and staff prior to consideration, recruit participants that were generally younger (ages 3-7) and either starting early intervention or school-age services, and minimize this threat by demonstrating zero-level responding during baseline for all participants. Even with these considerations, it is possible that learner history and potential differences in exposure to either modality may have influenced the results of this study.

Sixth, a slight modification to the procedures was made prior to intervention for Liam (Participant 1). Although the instruction procedures were not changed, the selection of items to be instructed was changed by substituting the typical validation trial in which a choice is

presented with the offering of just one item to be taken. This modification then precluded some of the instructional and assessment components relative to discrimination.

Seventh, discrimination probes did not appear reliable or indicative of learned discrimination for Hannah. In a field of two, guessing the correct item would occur about 50% of the time and guessing the correct item on three consecutive sessions would occur about 12.5% of the time. Hannah was especially inconsistent in demonstrating discrimination skills while Mandy retained her mastery for most items and Nelly was mostly accurate once reaching mastery criteria. More frequent measurement of discriminated requests or additional assessments of discrimination may enable participants' to better demonstrate their ability to discriminate while requesting items. In addition, the procedures surrounding the discrimination probe consistently provided confusion during intervention and were a bit cumbersome to implement.

Eighth, generalization probes conducted in this study were limited in scope and quantity. Sessions were somewhat artificial and specifically lacked a context for communication when starting with the items out of sight. Although aspects of the intervention environment were changed (actual items were out of sight, a different Giver was present, opportunities to request were set up in a different setting within the school building) the same requests were assessed and in less than "natural" environments and were only assessed for the two participants that met mastery criteria prior to the end of intervention. Another limitation of this study was an unfair test of generalization as the communication book provided an advantage that was evident in spontaneous requests for picture items and consistent with previous research findings (Anderson, 2001, Tincani, 2004). This advantage was not evident when looking at setting and person generalization, where slightly more requests were made with manual sign. This result provides additional support for the effects of the communication book as a cue for requesting. It is a limitation for comparing different modes of communication but can also be considered strength of picture training if the communication book is considered as a permanent antecedent prompt strategy. Overall research continues to indicate the need to evaluate generalization effects associated with AAC strategies (Ganz et al., 2012; Hart & Banda, 2010; Preston & Carter, 2009; Tien, 2008; Tincani & Devis, 2011).

Ninth, maintenance data were not attained during this study. Research indicates the need to demonstrate the maintenance of communication skills (Ganz, Earles-Vollrath, et al., 2012; Hart & Banda, 2010; Preston & Carter, 2009; Tien, 2008; Tincani & Devis, 2011) and that such skills may be lost following treatment (Howlin et al., 2007).

A final limitation is that this study looks at a very specific and narrow slice of “communication” that does not include the broader context of communication in terms of interactions, asking questions, and commenting on one’s environment. This step is a small area within a more comprehensive communication paradigm and does not adequately address requisite communication skills required for life-long development and self-determination.

Implications for Future Research

The current research is limited in scope and there are many areas to be addressed in future research. To date, there have been few comparison studies of picture and manual sign requests that were conducted within the school setting for individuals with ASD and ID (Adkins & Axelrod, 2001; Anderson, 2001; Chambers & Rehfeldt, 2003; Tincani, 2004) and in all of these interventions were implemented by researcher or research team. Research that focuses on using natural resources within public school settings is needed to examine feasibility and outcomes.

Second, the variability in procedures of studies claiming to use PECS, combined with other picture-based or exchanged-based procedures, creates a diverse range of methodology within the “mode” of pictures (not including issues of iconicity) that makes interpretation of the efficacy of intervention difficult if not impossible at this point. This ambiguity supports the current presumption that mode and methodology should be clearly separated and delineated in the literature and future studies.

Third, there are limited comparison research studies (Adkins & Axelrod, 2001; Anderson, 2001; Chambers & Rehfeldt, 2003; Gregory et al., 2009) that have attempted to level the playing field by equating two interventions as much as possible. Separating the form from the function can help clarify the relationship between different instructional methods, AAC modes, and specific learner characteristics. Practitioners can benefit from a protocol that can discriminate among these variables and help to inform educational decisions regarding communication for individuals

with ASD and ID. Future research may benefit from breaking down common AAC options (PECS, manual sign, VOCA) to the basic skills required of the learner (e.g., match to sample, scanning, motor imitation, and visual discrimination) for comparison among different intervention procedures. This may further clarify comparison research and the relationship between component skills, instructional methods, and learner characteristics.

Fourth, the consideration of fine motor skills is a common but inconsistent and undervalued variable across studies. Most studies rely on an assessment that is not standardized (Anderson, 2001; Gregory et al., 2009; Tincani, 2004), provided general categories of high/low motor skills without a specific assessment referenced, or do not address motor skills at all. There are numerous instruments that report fine motor skills and future research would benefit from identifying a tool that is accurate, reliable, and specific enough to serve as a predictor of success in manual sign instruction. It is also important that specific assessments delineate whether these skills are assessed in the context of an imitation task or reported as a level of development based on observations of student performance within a naturally occurring task. It is common practice to use modeling when teaching communication and this assumes that the student understands and can respond when expected to imitate. This is most relevant to how motor skills are assessed across studies to date.

Fifth, research may also consider evaluating the elemental fine motor formations of various manual signs (much like phonemes for vocal language) to produce a core “vocabulary” that could be specifically taught with high repetition. Further efforts may be considered that look at starting manual sign communication with meaningful motor approximations and building more complex formations as appropriate in a manner similar to that done with vocal approximations (Carbone et al., 2010).

Sixth, although discrimination is embedded into Phase III of the PECS, few studies report specifically on acquisition and rates of learning between different AAC options. This skill is critical to developing vocabulary in any mode of communication and future research is needed to explore how different modes, instructional methods, and learner characteristics relate to the acquisition of discrimination skills.

Seventh, regarding vocalizations, mild effects were achieved with only Mandy showing substantial levels of vocalizations. Research does suggest that using a time-delay procedure can facilitate vocalizations (Tincani, 2004) in individuals with ASD and ID. However, the ability to reliably produce vocalizations, which is considered the ultimate goal of any communication intervention, has not currently been identified or consistently associated with a particular AAC strategy or modality. More research is needed to examine how these variables interact with individual characteristics in the production of vocal responding in individuals with ASD and ID.

Eighth, a couple group studies and several single subject designs have been conducted in the past 10 years (Yoder & Stone, 2006b; Howlin, Gordon et al. 2007) that have begun to look at the interaction between learner characteristics and potential success with different AAC options. Randomized, controlled trials would provide an ideal effort to investigate the key learner characteristics that might include fine motor imitation, vocal imitation, and match-to-sample tasks.

Ninth, there continues to be a need to augment single-subject research designs with more group design research (randomized control trials) to evaluate the efficacy of PECS (Preston & Carter, 2009) and other individual AAC strategies and to compare different AAC options.

Tenth, research is needed to study the development of communication skills following mand training and whether there are specific milestones that can be assessed or instructed along this pathway. For example, repeated assessment of fine motor imitation, vocal imitation, matching, and other specific skills during the progression of communication training may show associations between these discrete skills and the acquisition of requests or discrimination with different AAC options. Ultimately, longitudinal research would address this need and that for more information on maintenance and generalization.

Finally, intervention team reports on Nelly's performance suggest that there may be some practical significance that would not be reported based solely on her level of independence. The intervention team indicated that manual signs appeared to be more successful although the data showed mixed results depending on whether one looks at mastery or overall independence across items. This discrepancy highlights the importance of attaining social validity and future research might consider whether outcomes focused upon by researchers are practically

meaningful. For example, mastery was set at 80% independence over three consecutive sessions. An interesting question might be what degree of independence is practically meaningful as reported by those implementing the intervention and, ultimately, others unrelated to the intervention that may interact with students throughout the daily routine.

Implications for Practice

This study potentially contributes to future practice in several ways. First, this study closely resembles practice within the educational setting as it is based upon the efforts of teachers and paraprofessionals rather than researchers and graduate students. Although intervention sessions were conducted with the student separate from classmates, these sessions were representative of programming and classroom procedures used on a daily basis. All four students had IEP goals that focused on requesting and teachers were able to use the procedures of this study to adequately address educational programs.

Second, this study showed high intervention integrity and IOA to support the feasibility of implementing a comparison of the two most common modes of communication by typical practitioners within the educational environment.

Third, the outcomes were less robust than commonly reported in the literature. The results of this study showed clear effects for at least one intervention for all four participants. Furthermore, this study clearly identified an optimal mode of communication for two of four participants and a promising course of action for the remaining two participants.

Fourth, Adkins and Axelrod (2001) and Gregory et al. (2009) conducted their intervention study with one trainer. It would be interesting to evaluate potential intervention outcomes based on whether one or two adults participated in the intervention and whether reduced resources would ultimately provide similar outcomes in making informed decisions for individual students.

Fifth, response to intervention can help decide which mode is best to focus on in the short term when highly motivating items are used. This study acknowledges the limited nature of requesting within the more complex domain of communication skills. However, in situations in which early communicators are struggling with challenging behaviors and unable to advocate for

their basic wants and needs, identifying an optimal mode of communication to address these concerns is an important first step for educators.

Conclusion

Research indicates that language ability is a reliable predictor of social, cognitive, and academic performance (Carson et al., 1997; Rutter et al., 1967) and that long-term positive outcomes for individuals with ASD and ID are highly correlated with the acquisition of functional communicative abilities (Koegel et al., 1999). Although the goals of most special education services are to promote independence and empowerment, and to provide specialized instruction, current barriers exist in that many major life decisions are often made by adults (Snyder, 2002). Research evaluating augmentative and alternative communication (AAC) options shows general support for a number of different strategies (e.g., manual sign, picture exchange) in teaching individuals with autism (ASD) and intellectual disabilities (ID) to request basic wants and needs (Ganz et al., 2012; Mirenda, 2003; Schlosser & Sigafoos, 2006; Tincani and Devis, 2011). However, research comparing the differential effects of AAC strategies for this population is limited and provides mixed results, lacking clear and objective guidelines for practitioners to make informed educational decisions when considering various AAC options for individual students. Without an established empirical framework to make these important decisions, practitioners would benefit from having a singular, concise, and systematic protocol for comparing communication strategies and making data-based decisions necessitated by the highly individualized nature of students with ASD and ID. To date, no studies have examined the feasibility of conducting this effort within the school setting with existing staff implementing the interventions and procedures.

Although this study did not demonstrate strong intervention effects across participants, it contributes to the research literature on communication instruction by replicating prior efforts to isolated different intervention effects to the specific mode of communication by equating instructional methods (Adkins & Axelrod, 2001; Anderson, 2001; Chambers & Rehfeldt, 2003; Gregory et al., 2009). In addition, it extends the literature as the first known study to do this within the school setting with teachers and paraprofessionals implementing the procedures. There was

a general consistency between results of this study with prior research in demonstrating idiosyncratic effects across participants (acquisition of requesting skills) and specific intervention effects within participants (higher independence with picture intervention, higher vocalizations with manual sign intervention). Combined with high levels of intervention integrity and solid IOA, the current investigation suggests that teachers can successfully implement and monitor a single method to compare modes of communication and make data-based decisions for individual students. Finally, this study provides a bridge between research and practice using naturally existing resources to empirically evaluate and isolate the effects of intervention on different modes of communication.

Table 1

Percent of Interobserver Agreement and Treatment integrity Across Participants

	Hannah	Mandy	Nelly	Liam
Interobserver Agreement Independence				
Picture	84.9	93.9	88.9	84.4
Manual Sign	96.3	80.9	85.8	96.8
Interobserver Agreement Discrimination				
Picture	89.5	93.3	87.0	
Manual Sign	87.0	88.2	80.8	
Interobserver Agreement Vocalizations				
Picture	98.0	95.9	96.8	100.0
Manual Sign	96.3	94.3	92.6	96.2
Intervention integrity				
Picture	96.7	94.7	95.5	99.2
Manual Sign	97.5	89.6	96.6	98.1

Table 2

Total Number of Intervention Trials and Sessions

		Picture Items			Sign Items		
		Item 1	Item 2	Item 3	Item 1	Item 2	Item 3
Hannah	Trials	193	228	193	103	13; 97 ^a	150
	Sessions	20	23	21	18	4; 12 ^a	16
Mandy	Trials	77	70	76	73	49	70
	Sessions	13	13	13	13	11	13
Nelly	Trials	137	186	188	160	181	184
	Sessions	21	21	21	21	21	21
Liam	Trials	138	210	167	166	171	167
	Sessions	18	19	19	20	20	20

Note. Items in bold face were mastered during intervention. Sessions were counted when items were validated for instruction.

^a This item was replaced due to low motivation after four sessions; data include the replacement item.

Table 3

Number of Trials and Sessions to Mastery for Independent Requests

		Picture Items			Sign Items		
		Item 1	Item 2	Item 3	Item 1	Item 2	Item 3
Hannah	Trials/Sessions	NM	NM	NM	NM	NM	NM
Mandy	Trials/Sessions	29/4	24/4	34/5	26/4	29/7	33/6
Nelly	Trials/Sessions	NM	NM	NM	NM	143/16	NM
Liam	Trials/Sessions	NM	210/19	NM	NM	NM	NM

Note. NM = not mastered

Table 4

Number of Trials and Sessions to Mastery for Discriminated Requests

		Picture Items			Sign Items		
		Item 1	Item 2	Item 3	Item 1	Item 2	Item 3
Hannah	Trials	73/8	30/3	183/20	21/3	42/7	30/3
Mandy	Trials	29/4	24/4	29/4	26/4	13/4	22/4
Nelly	Trials	NM	30/3	70/7	NM	40/4	49/5
Liam	Trials						

Note. NM = not mastered.

Table 5

Perent of Non-overlapping Data Between Baseline and Intervention

	Picture	Sign
Hannah	65.2	0.0
Mandy	100.0	100.0
Nelly	85.7	85.7
Liam	63.2	0.0

Figure 1

Percent of Independent Requests Using Pictures or Signs for Hannah and Mandy

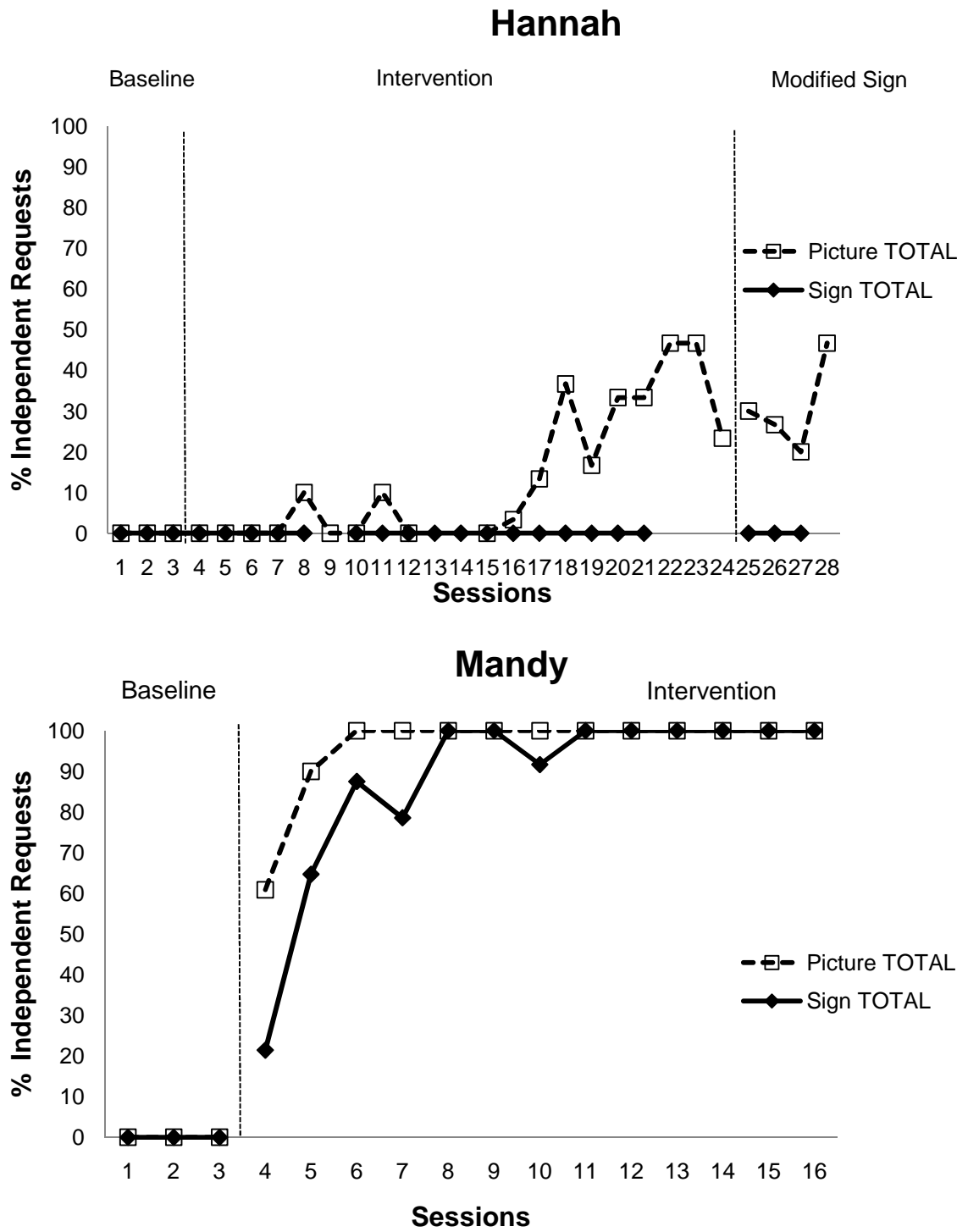


Figure 2

Percent of Independent Requests Using Pictures or Signs for Nelly and Liam

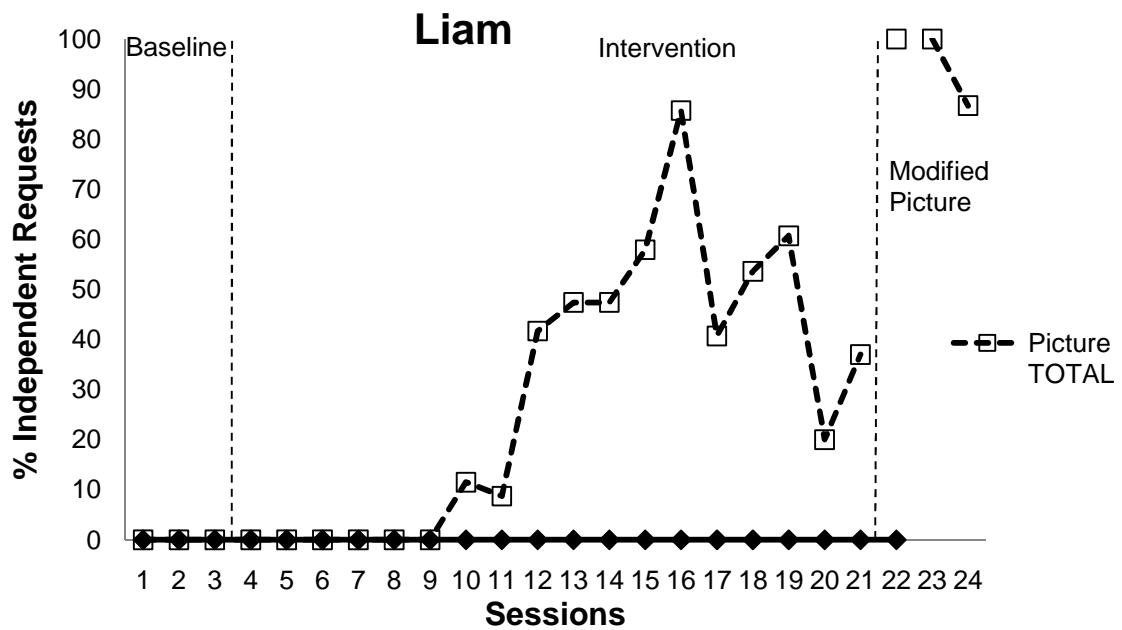
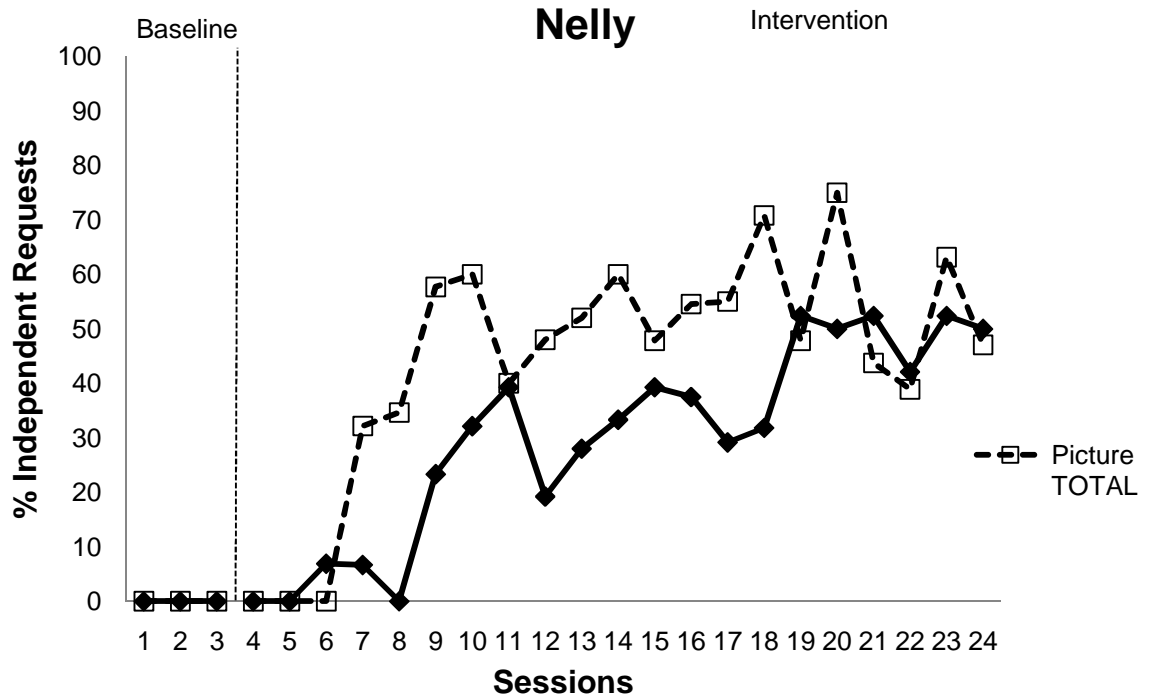


Figure 3

Number of Independent Requests Mastered

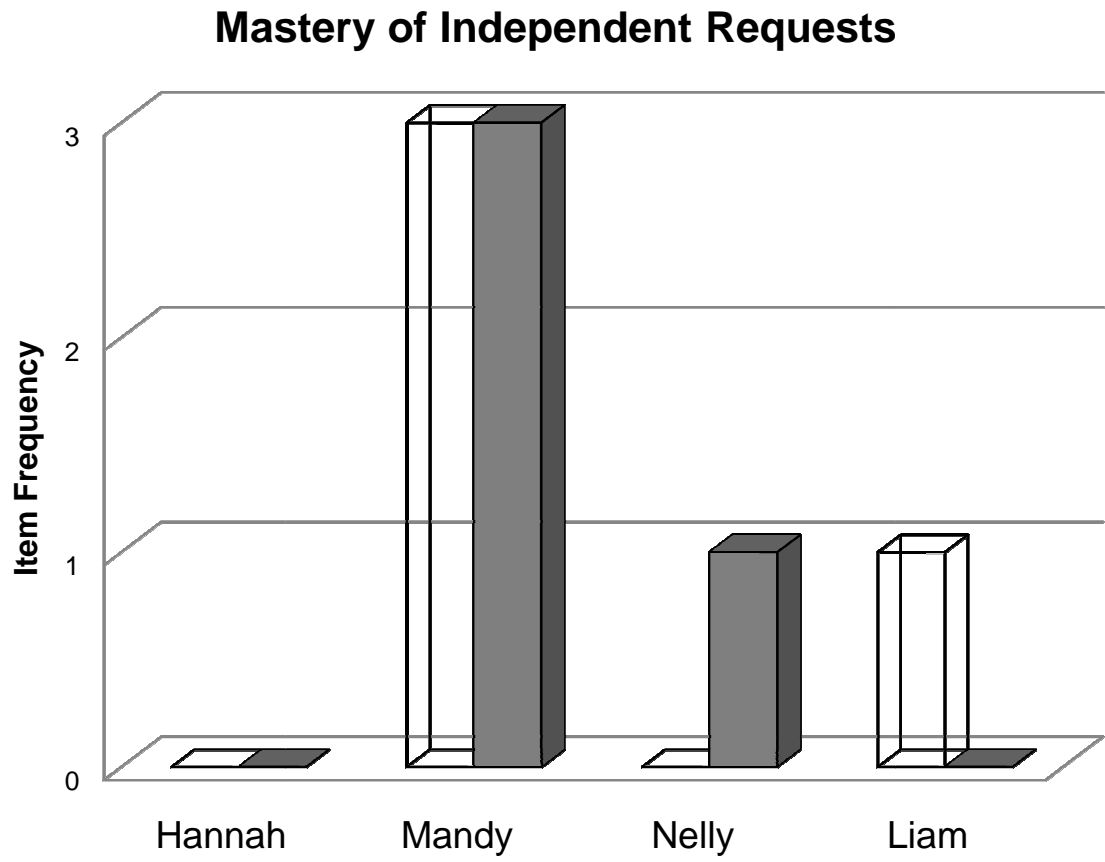


Figure 4

Average Percent of Independent Requests Across Sessions for Each Participant

Average Independence for Individual Items Across Sessions

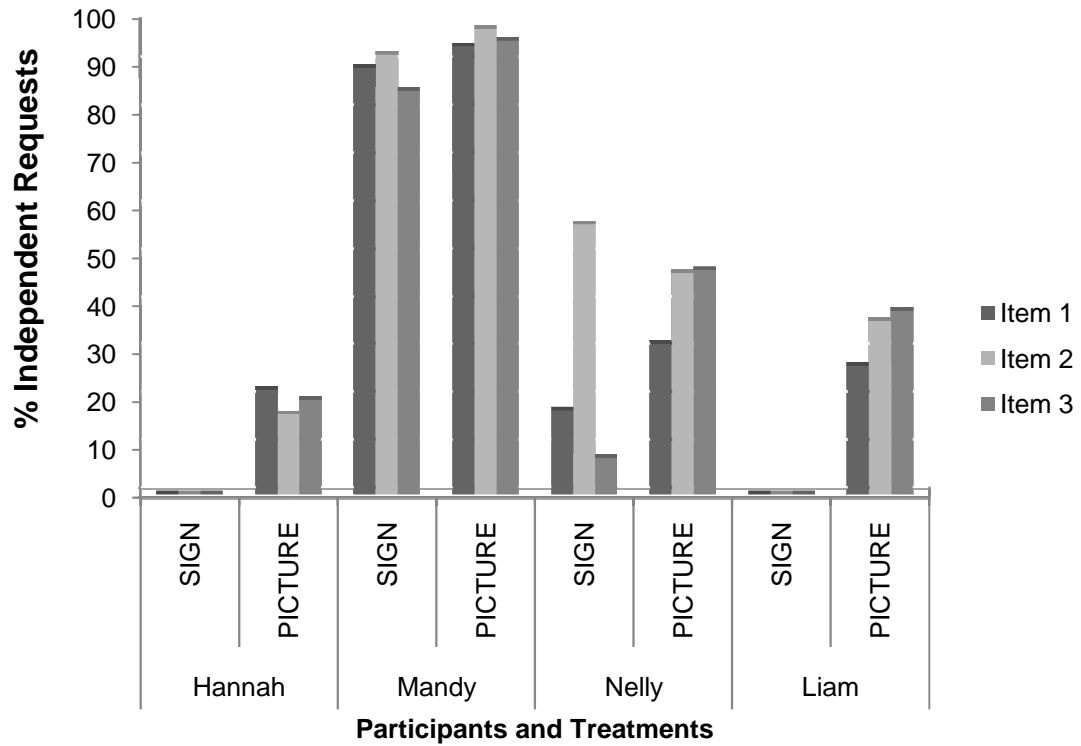


Figure 5

Frequency of Discriminated Requests Mastered

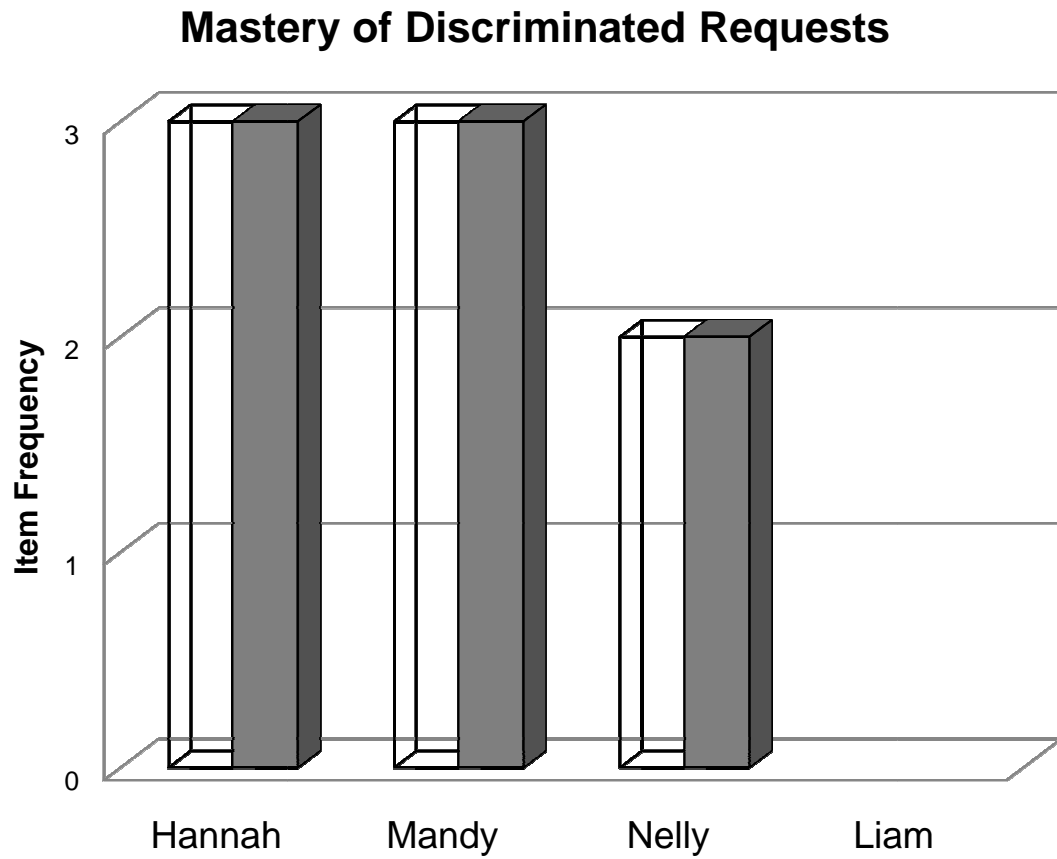


Figure 6

Average Percent Discriminated Requests for Each Intervention

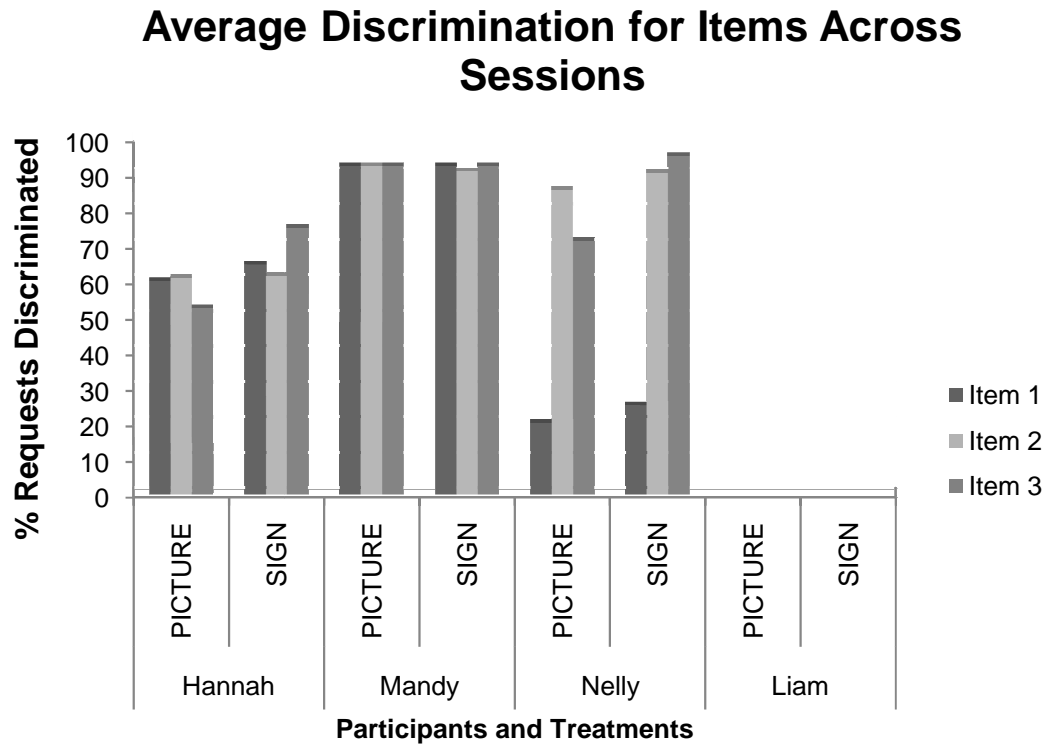


Figure 7

Intervention Vocalizations Across Targets for Hannah and Mandy

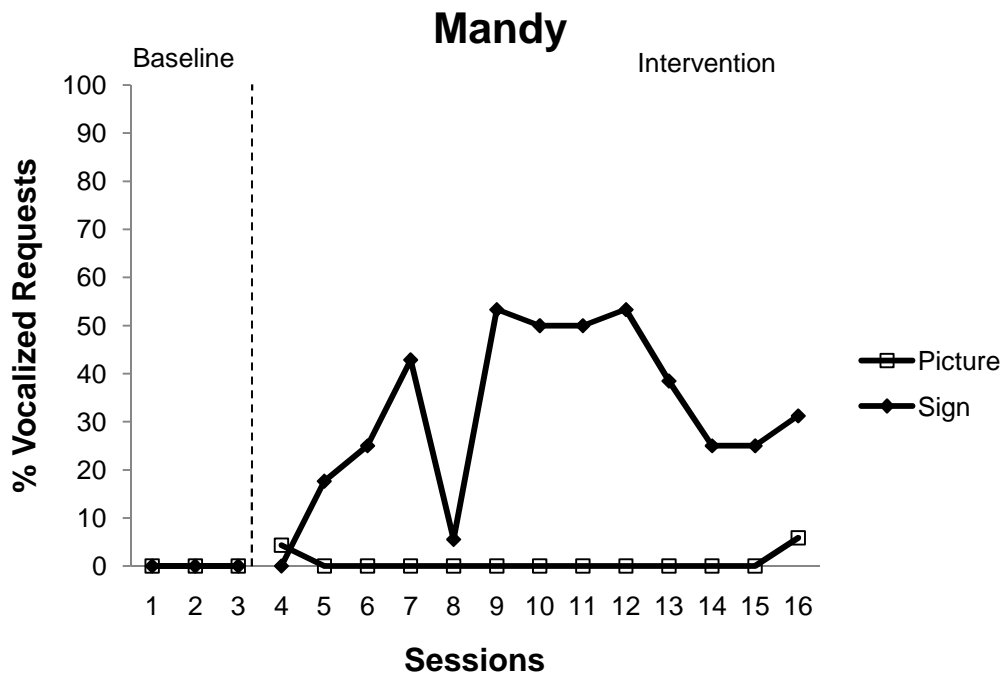
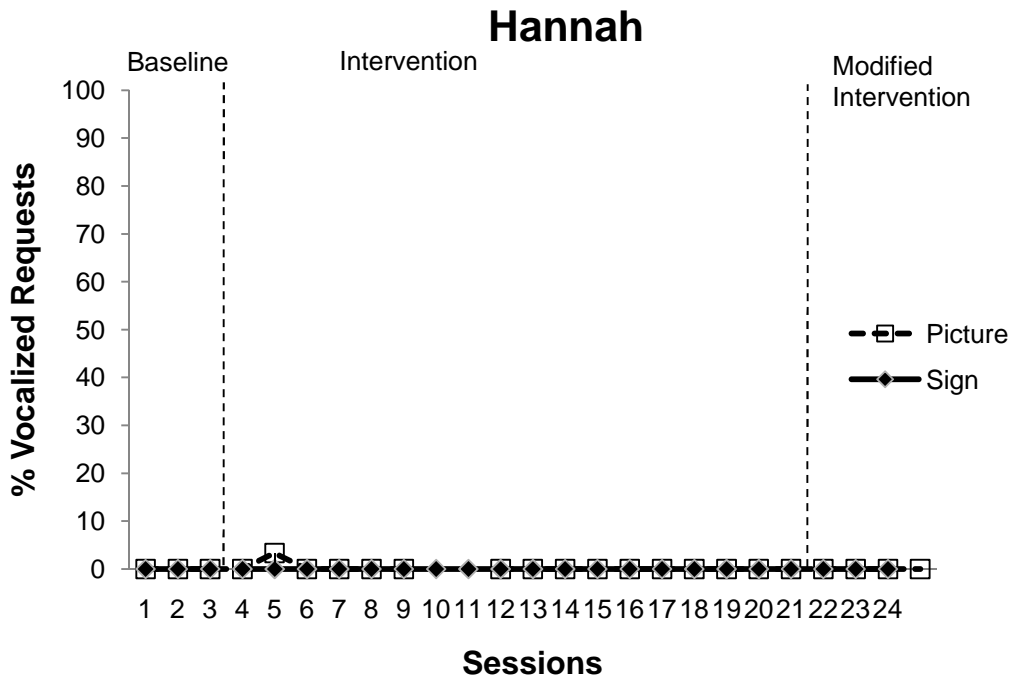


Figure 8

Intervention Vocalizations Across Targets for Nelly and Liam

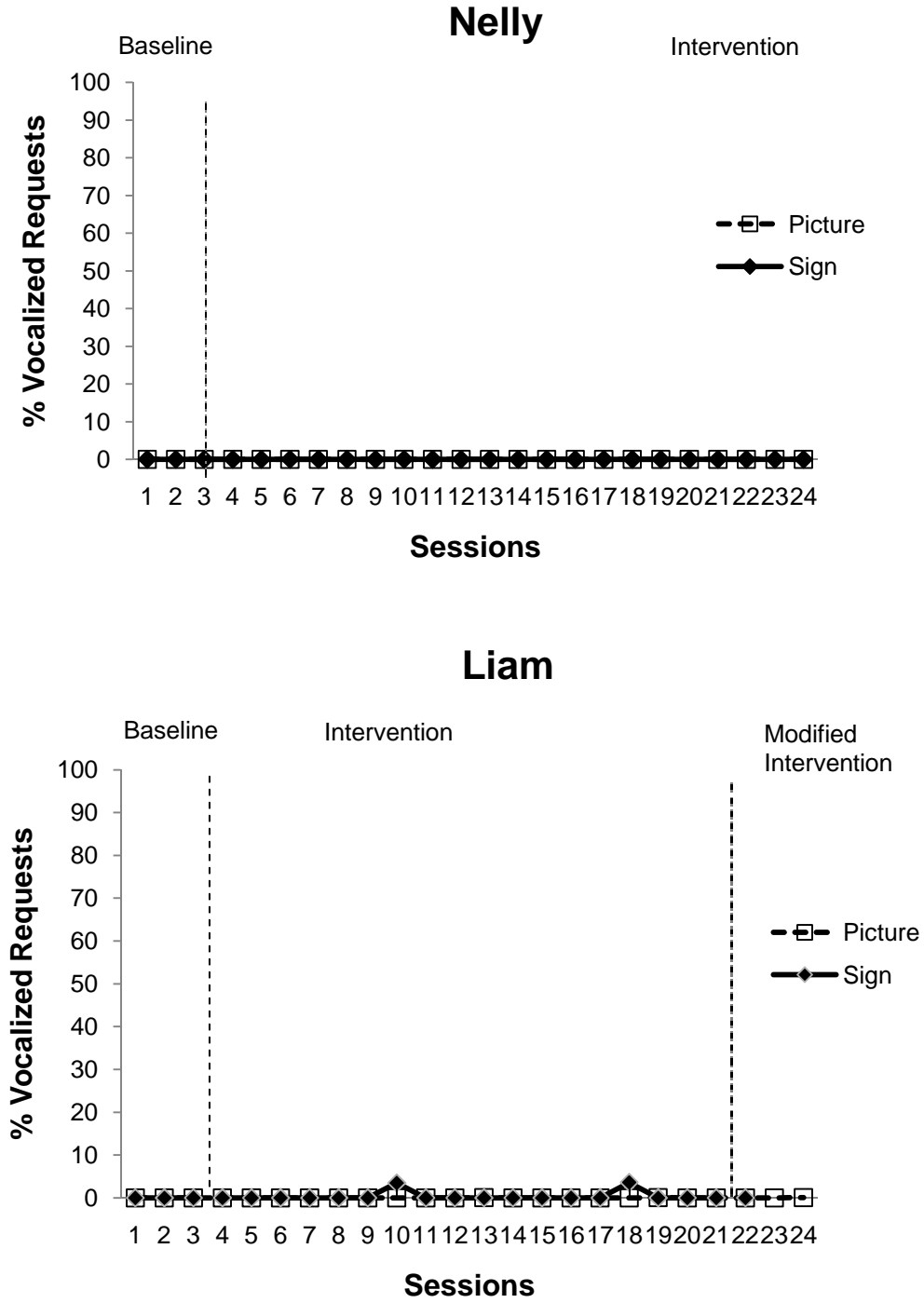


Figure 9

Frequency of Requests During Generalization Probes for Hannah and Mandy

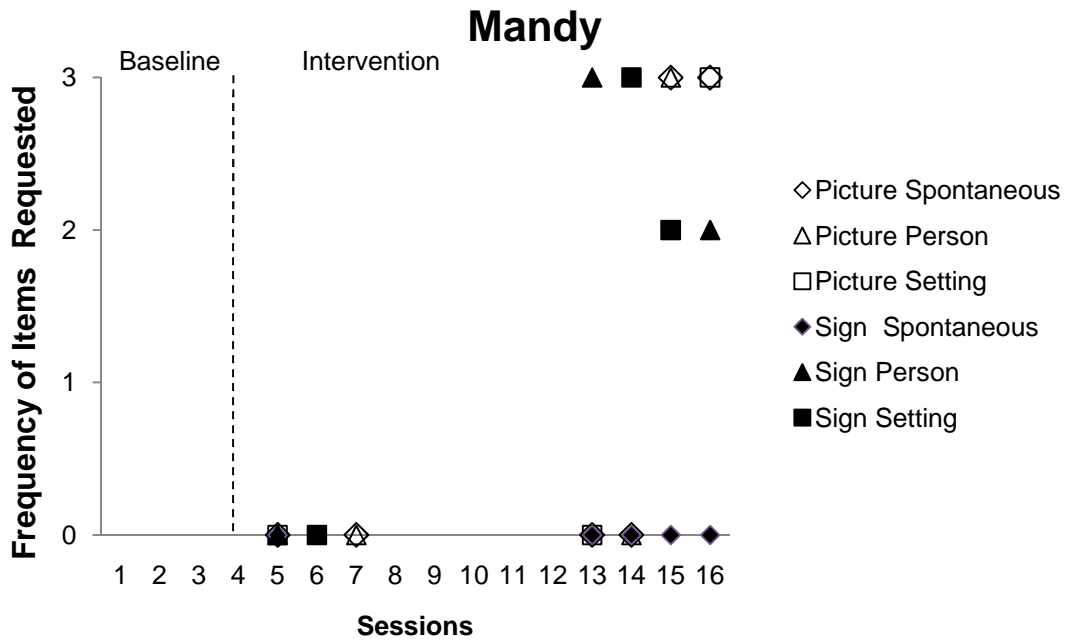
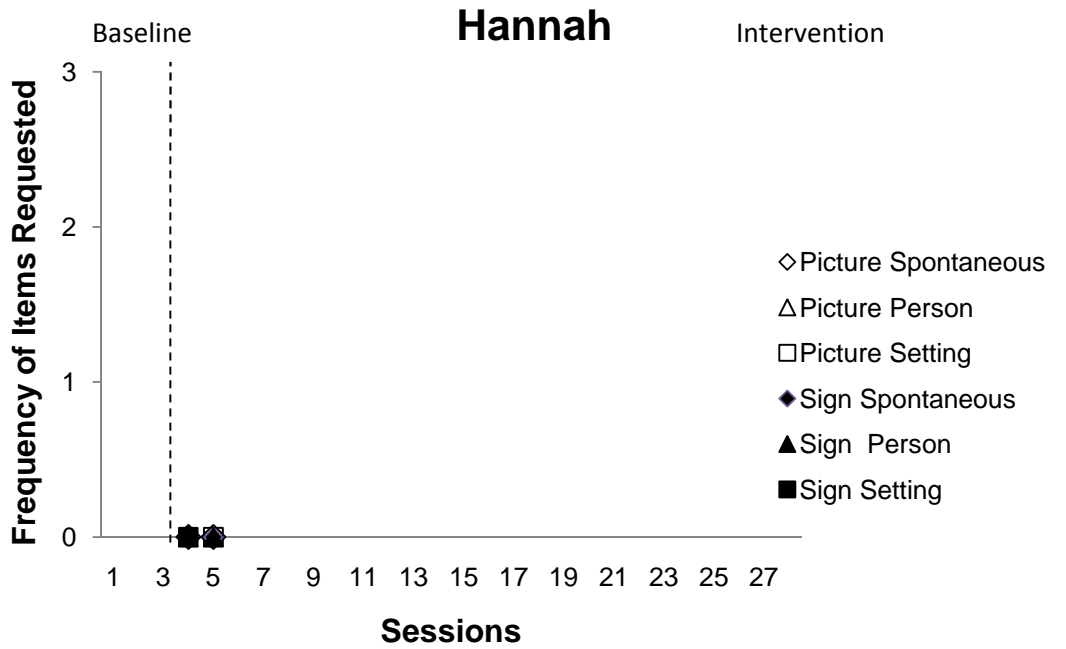
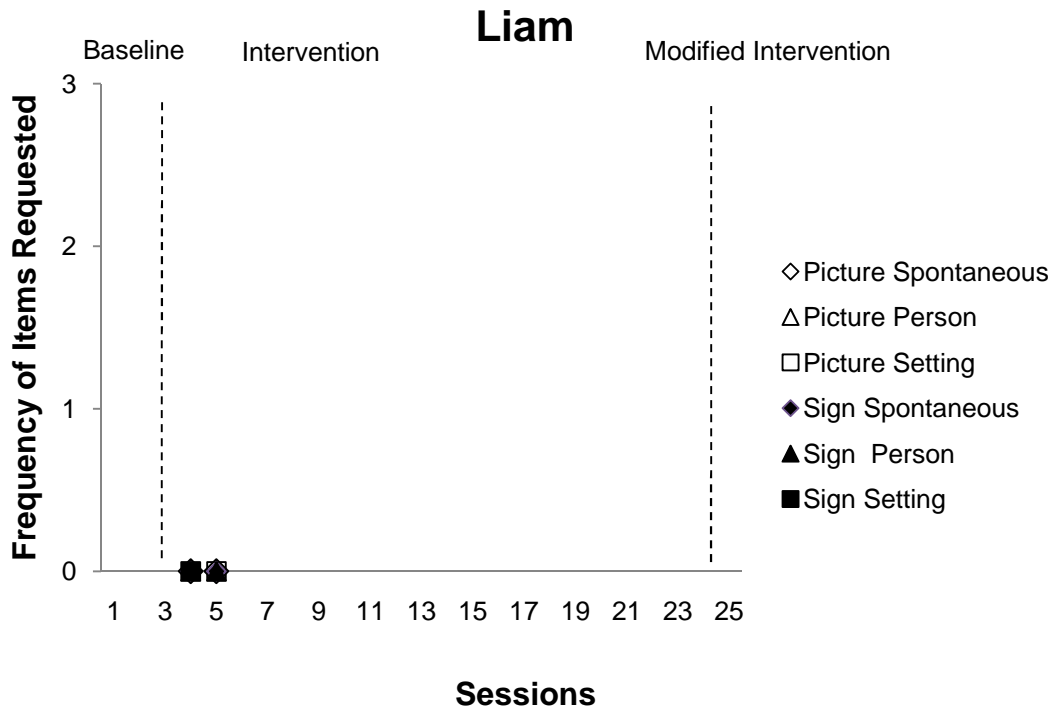
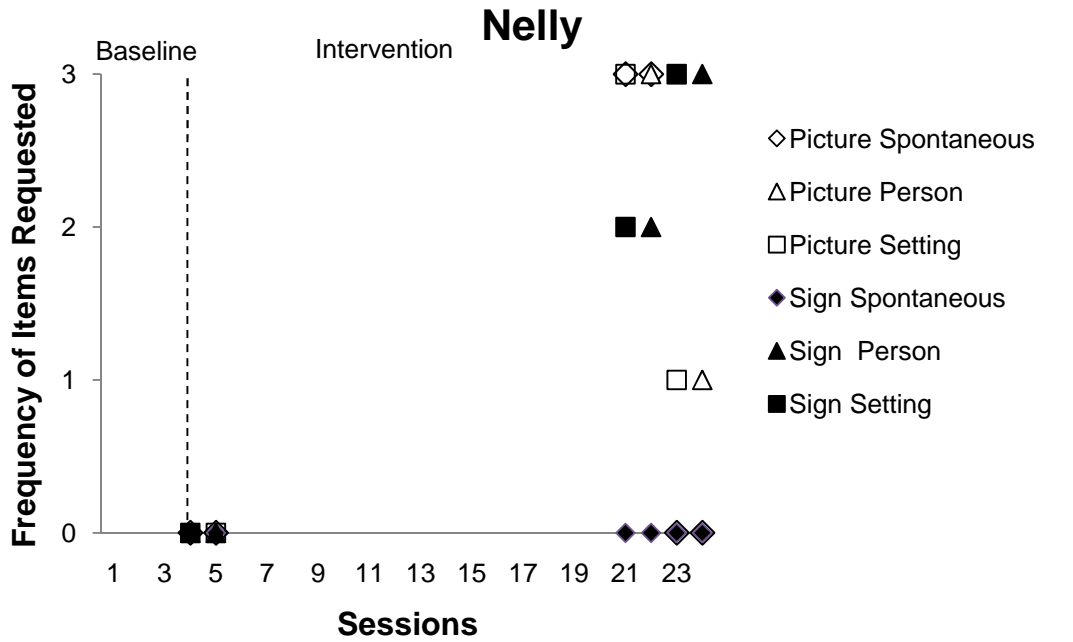


Figure 10

Frequency of Requests During Generalization Probes for Nelly and Liam



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Appendix A

Study Description and Teacher Consent Form

Dear Educator:

I am conducting a research study focusing on teaching students to communicate using manual sign and pictures. This study will assess preferred items and provide intervention in the use of these communication modalities. This study would require two adults to conduct two sessions per day (about 10-15 minutes each) that would look much like a snack time or free play activity. Sessions were conducted for 3-4 days per week over the course of approximately 8-10 weeks and would be video recorded. Criteria for inclusion in the study include students that:

1. Are between 3 and 10 years of age.
2. Have an independent diagnosis of Autistic Disorder, mental retardation, or Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS).
3. Do not have an established communication system in place.
4. No formal training or ability to communicate using manual signing or pictures.
5. Have limited functional expressive word vocabularies (3 or less).
6. Do not have a medical condition or disability that would interfere with mand training (e.g., Prader Willi Syndrome, visual or hearing impairment).
7. Are motivated by a minimum of six items (e.g., food, objects).

If you are interested in participating in this study or have additional questions, please feel free to contact me.

Daniel Curtis
Certified School Psychologist, Carbon Lehigh Intermediate Unit
Doctoral Candidate, Lehigh University
610-769-4111 X 1642
curtisd@cliu.org
dacm@lehigh.edu

TEACHER CONSENT LETTER

Dear Educator:

This is a letter requesting your participation in a study designed to examine the effects of communication intervention using both manual sign and pictures on your student's ability to request preferred items within the school environment. The project was conducted by Mr. Daniel Curtis, a doctoral student in School Psychology, under the supervision of Dr. Christine L. Cole, a faculty member in School Psychology at Lehigh University.

The purpose of this study is to identify the best communication system for your student to communicate their wants and needs in place of inappropriate behavior (e.g., tantrums, crying) that may result from frustration due to communication difficulties. As the experimenter, Mr. Curtis will facilitate and support educational staff in the implementation of communication intervention. All intervention procedures used will be positive behavioral strategies. All project activities will occur during the course of your child's normal school day activities.

Specifically, your student will be taught to perform manual signs or exchange picture icons in order to access preferred items. This study will assess which items are preferred and provide you with the materials and brief training on how to teach the use of these communication modalities. You would be required to conduct two sessions per day (about 10-15 minutes each) for 3-4 days per week over approximately 8-10 weeks along with a second adult. Sessions will look much like a snack time or free play activity. Adult participants will be asked to complete a weekly checklist reviewing intervention procedures and to provide feedback on a brief questionnaire when the study concludes. It would be desirable to videotape intervention sessions in order to ease the process of data collection, minimize the number of adults involved in the learning process, and to share this process with other professional for training purposes. Daniel Curtis will provide support and guidance on a regular basis. The possible benefits include providing your student with an effective communication modality, reducing challenging behaviors, and learning to implement research-based interventions that can be used with other students in the future.

Please know that your identity will remain confidential. Your participation is completely voluntary and you are free to withdraw from this project at any time without jeopardizing your relationship with your employer or Lehigh University.

Any questions about the project can be directed to Daniel Curtis (610-739-0624) or Dr. Cole (610-758-3270). Please report problems resulting from participation in this study to Ruth L. Tallman, Office of Research and Sponsored Programs, Lehigh University, (610-758-3024).

I have read and understand the foregoing information. I hereby consent to participate in the investigation described.

Date

Signature of Education Personnel

Please check whether or not you consent to the use of video in this study:

____ I give consent for video to be used as described above

____ I do not give consent for video to be used at all

NOTE: Please sign both copies, keep one, and return one copy to Daniel Curtis. Thank you!

Appendix B
Parent Consent Form

PARENT CONSENT LETTER

Dear Parent,

Your son/daughter, _____, has been selected for possible participation in a research study designed to teach basic communication skills. The project will examine the effects of communication intervention using sign language and pictures on your son's/daughter's ability to ask for some of their favorite snacks or toys. The project will be conducted by Mr. Daniel Curtis, a doctoral student in School Psychology and certified school psychologist, under the supervision of Dr. Christine L. Cole, a faculty member in School Psychology at Lehigh University.

The purpose of this project is to identify the best communication system for your child and teach them how to communicate their wants and needs. Your child has been recommended for participation in this study because he/she does not appear to use pictures or sign language to communicate in the classroom. Sometimes, children that are not able to let us know what they want use inappropriate behavior (e.g., tantrum, crying) when frustrated by communication difficulties. As the experimenter, Mr. Curtis will facilitate and support the process by assisting classroom staff in communication intervention. All procedures used in this project will be positive and attempt to increase your child's skills. Specifically, your child will be taught to perform manual signs or exchange picture icons in order to access preferred items. To monitor your child's progress, his/her participation and behavior will be observed within the classroom. It would be desirable to have sessions videotaped so they can be reviewed by observers and Mr. Curtis in order to minimize distraction, support the intervention process, and to share this process with other professionals for training purposes. These videotapes would be available for you to review and would not be used for other purposes. All project activities will occur during the course of your child's normal school day activities.

You should be aware there is a small chance your child may react negatively to changes implemented during this project as he/she is learning a skill that may be hard at first. However, efforts will be made to reduce this risk as much as possible. On the other hand, the possible benefits to your child from participation in this project include learning to communicate with various adults to request items that he/she wants, finding a communication system that works, and possibly reducing challenging behavior that may result from frustration related to your child's communication difficulties.

Please know that your child's identity will remain confidential. Your participation is completely voluntary and you are free to withdraw your child from this project at any time without jeopardizing your relationship with your child's school or Lehigh University.

Any questions about the project can be directed to Daniel Curtis (610-739-0624) or Dr. Cole (610-758-3270). Please report problems resulting from participation in this study to Ruth L. Tallman, Office of Research and Sponsored Programs, Lehigh University, (610-758-3024).

I have read and understand the foregoing information and hereby consent to the participation of _____, a minor as a subject in the scientific investigation described.

Date

Signature of Parent or Guardian

Please check whether or not you consent to the use of video in this study:

____ I give consent for video to be used as described above

____ I do not give consent for video to be used at all

NOTE: Please sign both copies and return one copy to your child's teacher. Thank you!

Appendix C
Baseline Data Sheet

Baseline Data Sheet

Student:
Prompter:

Date:
Observer:

Time:
Session:

Setting:

Giver:

Interobserver agreement: Y / N

Item	Accept/Reject (O/X)	Sign (S); picture communication (P) Vocal (V) Non-word (NW) Reach/Other X					Challenging Behavior (Describe & Tally)	Rejection (Tally)
Picture Intervention Stimuli								
1.	1 2 3 4 5 6							
2.	1 2 3 4 5 6							
3.	1 2 3 4 5 6							
Manual Sign Intervention Stimuli								
1.	1 2 3 4 5 6							
2.	1 2 3 4 5 6							
3.	1 2 3 4 5 6							

Appendix D

Picture Intervention Data Sheet

Picture Intervention Data Sheet

Student: _____ **Date:** _____ **Time:** _____ **Setting:** _____ **Giver:** _____
Prompter: _____ **Observer:** _____ **Session:** _____ **Interobserver agreement:** Y / N

Validation (O/X)	Target 1	1	2	3	4	5	6	7	8	9	10
1 2 3 4 5											
Circle Prompt for both steps	Select Icon	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP
	Deliver Icon	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP
Word (W) Non-word (NW)		W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW
Discrimination Probe - Trial 1		Yes No									
Validation (O/X)	Target 2	1	2	3	4	5	6	7	8	9	10
1 2 3 4 5											
Circle Prompt for both steps	Select Icon	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP
	Deliver Icon	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP
Word (W) Non-word (NW)		W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW
Discrimination Probe - Trial 1		Yes No									
Validation (O/X)	Target 3	1	2	3	4	5	6	7	8	9	10
1 2 3 4 5											
Circle Prompt for both steps	Select Icon	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP
	Deliver Icon	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP
Word (W) Non-word (NW)		W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW
Discrimination Probe - Trial 1		Yes No									

Appendix E

Manual Sign Intervention Data Sheet

Manual Sign Intervention Data Sheet

Student: _____ **Date:** _____ **Time:** _____ **Setting:** _____ **Giver:** _____
Prompter: _____ **Observer:** _____ **Session:** _____ **Interobserver agreement:** Y / N

Validation (O/X)	Target 1	1	2	3	4	5	6	7	8	9	10
1 2 3 4 5											
Circle Prompt for each trial	Manual Sign	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP
Word (W) Non-word (NW)		W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW
Discrimination Probe - Trial 1		Yes No									
Validation (O/X)	Target 2	1	2	3	4	5	6	7	8	9	10
1 2 3 4 5											
Circle Prompt for each trial	Manual Sign	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP
Word (W) Non-word (NW)		W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW
Discrimination Probe - Trial 1		Yes No									
Validation (O/X)	Target 3	1	2	3	4	5	6	7	8	9	10
1 2 3 4 5											
Circle Prompt for each trial	Manual Sign	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP	FP PP
Word (W) Non-word (NW)		W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW	W NW
Discrimination Probe - Trial 1		Yes No									

Appendix F

Picture Intervention Integrity Data Sheet

Picture Training Integrity Data Sheet

PICTURE INTERVENTION– GENERAL PROCEDURES						
Trainers Positioned Appropriately (Giver across, Prompter behind/beside)	Y	N				
Each Item Was Presented for 5-10 Trials Unless Discontinue Criteria Met	Y	N				
Giver Refrains From Additional Language (e.g., that's right, correct, good job)	Y	N				
Giver Refrains From Prompting the Student	Y	N				
No Verbal Prompting	Y	N				
Prompter Attempts to Fade Prompts After at Least Three Consecutive Correct Responses	Y	N	N/A			
Following an Error, the Prompter Reverts to the Previous Level of Prompting	Y	N	N/A			
Prompter Does Not Socially Interact With Student	Y	N				
Prompter Varies Location of Pictures on Book (diagonal, vertical, horizontal)	Y	N				
VALIDATIONS						
Validation Trial with Two Objects Presented, One in Each Hand	Y	N	Y	N	Y	N
Free Delivery (Label and Display Icon) If Student Takes One	Y	N	Y	N	Y	N
If Student Does Not Choose An Item After 15 Seconds, Start Next Validation	N/A		Y	N	Y	N
Student Tries To Take Both Items, Giver Blocks and Starts Same Trial Over	N/A		Y	N	Y	N

Picture Training Integrity Data Sheet

PICTURE INTERVENTION - _____ (Object 1)										
Two Icons Placed on Book Matching Validation Field	Y	N	Y	N	Y	N	Y	N	Y	N
Giver Entices Student With Item	Y	N	Y	N	Y	N	Y	N	Y	N
Prompter Waits For Student Initiation	Y	N	Y	N	Y	N	Y	N	Y	N
If No Initiation After 10 seconds, Move On To Next Validation Trial	N/A		Y	N	Y	N	Y	N	Y	N
Prompter Provides Least intrusive Prompt To Select _____ (Object 1)	Y	N	Y	N	Y	N	Y	N	Y	N
Prompt Occurs Within 1 Second Of Student Initiation (No Student Errors)	Y	N	Y	N	Y	N	Y	N	Y	N
Prompter Provides Least intrusive Prompt To Deliver _____ (Object 1)	Y	N	Y	N	Y	N	Y	N	Y	N
Prompt Occurs Within 1 Second Of Student Initiation (No Student Errors)	Y	N	Y	N	Y	N	Y	N	Y	N
Discrimination Probe on 1 st trial – Giver Re-presents Validation Field and Says “Take It”									Y	N
Student Takes Corresponding Item (With Prompting, or Blocking as Needed)									Y	N
Immediate Delivery of Item With Label and Icon Displayed	Y	N	Y	N	Y	N	Y	N	Y	N
Student Allowed Access Up to 15 Seconds	Y	N	Y	N	Y	N	Y	N	Y	N
If Satiation Indicated, Move On To Next Validation Trial	N/A		Y	N	Y	N	Y	N	Y	N
If Student Makes An Error, Restart Trial With Giver Enticing Student	N/A		Y	N	Y	N	Y	N	Y	N

Picture Intervention Integrity Data Sheet

PICTURE INTERVENTION - _____ (Object 2)						
Two Icons Placed on Book Matching Validation Field	Y	N	Y	N	Y	N
Giver Entices Student With Item	Y	N	Y	N	Y	N
Prompter Waits For Student Initiation	Y	N	Y	N	Y	N
If No Initiation After 10 seconds, Move On To Next Validation Trial	N/A	Y	N	Y	N	Y
Prompter Provides Least intrusive Prompt To Select _____ (Object 2)	Y	N	Y	N	Y	N
Prompt Occurs Within 1 Second Of Student Initiation (No Student Errors)	Y	N	Y	N	Y	N
Prompter Provides Least intrusive Prompt To Deliver _____ (Object 2)	Y	N	Y	N	Y	N
Prompt Occurs Within 1 Second Of Student Initiation (No Student Errors)	Y	N	Y	N	Y	N
Discrimination Probe on 1 st trial – Giver Re-presents Validation Field and Says “Take It”					Y	N
Student Takes Corresponding Item (With Prompting, or Blocking as Needed)					Y	N
Immediate Delivery of Item With Label and Icon Displayed	Y	N	Y	N	Y	N
Student Allowed Access Up to 15 Seconds	Y	N	Y	N	Y	N
If Satiation Indicated, Move On To Next Validation Trial	N/A	Y	N	Y	N	Y
If Student Makes An Error, Restart Trial With Giver Enticing Student	N/A	Y	N	Y	N	Y

Picture Intervention Integrity Data Sheet

PICTURE INTERVENTION - _____ (Object 3)										
Two Icons Placed on Book Matching Validation Field	Y	N	Y	N	Y	N	Y	N	Y	N
Giver Entices Student With Item	Y	N	Y	N	Y	N	Y	N	Y	N
Prompter Waits For Student Initiation	Y	N	Y	N	Y	N	Y	N	Y	N
If No Initiation After 10 seconds, Move On To Next Validation Trial	N/A		Y	N	Y	N	Y	N	Y	N
Prompter Provides Least intrusive Prompt To Select _____ (Object 3)	Y	N	Y	N	Y	N	Y	N	Y	N
Prompt Occurs Within 1 Second Of Student Initiation (No Student Errors)	Y	N	Y	N	Y	N	Y	N	Y	N
Prompter Provides Least intrusive Prompt To Deliver _____ (Object 3)	Y	N	Y	N	Y	N	Y	N	Y	N
Prompt Occurs Within 1 Second Of Student Initiation (No Student Errors)	Y	N	Y	N	Y	N	Y	N	Y	N
Discrimination Probe on 1 st trial – Giver Re-presents Validation Field and Says “Take It”									Y	N
Student Takes Corresponding Item (With Prompting, or Blocking as Needed)									Y	N
Immediate Delivery of Item With Label and Icon Displayed	Y	N	Y	N	Y	N	Y	N	Y	N
Student Allowed Access Up to 15 Seconds	Y	N	Y	N	Y	N	Y	N	Y	N
If Satiation Indicated, Move On To Next Validation Trial	N/A		Y	N	Y	N	Y	N	Y	N
If Student Makes An Error, Restart Trial With Giver Enticing Student	N/A		Y	N	Y	N	Y	N	Y	N

Appendix G

Manual Sign Intervention Integrity Data Sheet

Manual Sign Intervention Integrity Data Sheet

MANUAL SIGN INTERVENTION – GENERAL PROCEDURES						
Trainers Positioned Appropriately (Giver across, Prompter behind/beside)	Y	N				
Each Item Was Presented for 5-10 Trials Unless Discontinue Criteria Met	Y	N				
Giver Refrains From Additional Language (e.g., that's right, correct, good job)	Y	N				
Giver Refrains From Prompting the Student	Y	N				
No Verbal Prompting	Y	N				
Prompter Attempts to Fade Prompts After at Least Three Consecutive Correct Responses	Y	N	N/A			
Following an Error, the Prompter Reverts to the Previous Level of Prompting	Y	N	N/A			
Prompter Ensures Student's Hands Are Not "Busy" Prior To Requests	Y	N	N/A			
Prompter Does Not Socially Interact With Student	Y	N				
VALIDATIONS						
Validation Trial with Two Objects Presented, One in Each Hand	Y	N	Y	N	Y	N
Free Delivery (Label and Model Sign) If Student Takes One	Y	N	Y	N	Y	N
If Student Does Not Choose An Item After 15 Seconds, Start Next Validation	N/A		Y	N	Y	N
Student Tries To Take Both Items, Giver Blocks and Starts Same Trial Over	N/A		Y	N	Y	N

Manual Sign Intervention Integrity Data Sheet

MANUAL SIGN INTERVENTION _____ OBJECT 1								
Giver Entices Student With Item	Y	N	Y	N	Y	N	Y	N
Prompter Waits For Student Initiation	Y	N	Y	N	Y	N	Y	N
If No Initiation After 10 seconds, Move On To Next Validation Trial	N/A		Y	N	Y	N	Y	N
Prompter Provides Least intrusive Prompt To Sign for _____ (Object 1)	Y	N	Y	N	Y	N	Y	N
Prompt Occurs Within 1 Second Of Student Initiation (No Student Errors)	Y	N	Y	N	Y	N	Y	N
Discrimination Probe on 1 st trial – Giver Re-presents Validation Field and Says "Take It"							Y	N
Student Takes Corresponding Item (With Prompting, or Blocking as Needed)							Y	N
Immediate Delivery of Item With Label and Modeled Sign	Y	N	Y	N	Y	N	Y	N
Student Allowed Access Up to 15 Seconds	Y	N	Y	N	Y	N	Y	N
If Satiation Indicated, Move On To Next Validation Trial	N/A		Y	N	Y	N	Y	N
If Student Makes An Error, Restart Trial With Giver Enticing Student	N/A		Y	N	Y	N	Y	N

Manual Sign Intervention Integrity Data Sheet

MANUAL SIGN INTERVENTION _____ OBJECT 2								
Giver Entices Student With Item	Y	N	Y	N	Y	N	Y	N
Prompter Waits For Student Initiation	Y	N	Y	N	Y	N	Y	N
If No Initiation After 10 seconds, Move On To Next Validation Trial	N/A		Y	N	Y	N	Y	N
Prompter Provides Least intrusive Prompt To Sign for _____ (Object 2)	Y	N	Y	N	Y	N	Y	N
Prompt Occurs Within 1 Second Of Student Initiation (No Student Errors)	Y	N	Y	N	Y	N	Y	N
Discrimination Probe on 1 st trial – Giver Re-presents Validation Field and Says "Take It"							Y	N
Student Takes Corresponding Item (With Prompting, or Blocking as Needed)							Y	N
Immediate Delivery of Item With Label and Modeled Sign	Y	N	Y	N	Y	N	Y	N
Student Allowed Access Up to 15 Seconds	Y	N	Y	N	Y	N	Y	N
If Satiation Indicated, Move On To Next Validation Trial	N/A		Y	N	Y	N	Y	N
If Student Makes An Error, Restart Trial With Giver Enticing Student	N/A		Y	N	Y	N	Y	N

Manual Sign Intervention Integrity Data Sheet

MANUAL SIGN INTERVENTION _____ OBJECT 3								
Giver Entices Student With Item	Y	N	Y	N	Y	N	Y	N
Prompter Waits For Student Initiation	Y	N	Y	N	Y	N	Y	N
If No Initiation After 10 seconds, Move On To Next Validation Trial	N/A		Y	N	Y	N	Y	N
Prompter Provides Least intrusive Prompt To Sign for _____ (Object 3)	Y	N	Y	N	Y	N	Y	N
Prompt Occurs Within 1 Second Of Student Initiation (No Student Errors)	Y	N	Y	N	Y	N	Y	N
Discrimination Probe on 1 st trial – Giver Re-presents Validation Field and Says "Take It"							Y	N
Student Takes Corresponding Item (With Prompting, or Blocking as Needed)							Y	N
Immediate Delivery of Item With Label and Modeled Sign	Y	N	Y	N	Y	N	Y	N
Student Allowed Access Up to 15 Seconds	Y	N	Y	N	Y	N	Y	N
If Satiation Indicated, Move On To Next Validation Trial	N/A		Y	N	Y	N	Y	N
If Student Makes An Error, Restart Trial With Giver Enticing Student	N/A		Y	N	Y	N	Y	N

Appendix H

Generalization Probe Data Sheets: Manual sign and picture communication

Generalization Probe Data Sheet

Student: _____ **Date:** _____ **Time:** _____ **Setting:** _____
Observer: _____ **Session #:** _____ **IOA: Y / N** _____
Generalization to: Person _____ or Setting _____ (circle and detail)

Picture Intervention or Manual Sign Intervention (circle one)

Target	Spontaneous Mand	Independent Mand
	Yes / No	Yes / No
	Yes / No	Yes / No
	Yes / No	Yes / No

The following questions were completed at the end of each week in conjunction with informal interviews or discussion with the investigator:

1. Did the student make any requests outside of intervention?
2. If so, how many or how frequently? What was requested? With whom? Where? When?
3. What was going on at the time?
4. Where was the communication book (if picture intervention)?

Appendix I

Paired Stimulus Preference Assessment Data Sheet

Paired Stimulus Preference Assessment Data Sheet

Student:

Date:

Setting:

Observer:

Session:

Interobserver agreement: Y / N

Write in the name of each item below next to each number to be assigned. As each pair of items is presented, please record the assigned number for the item selected in the grid below until all of the unshaded boxes are filled. Tally each number written in the boxes and write the total in the parentheses following the name of each item below.

Item 1 =	()	Item 6 =	()
Item 2 =	()	Item 7 =	()
Item 3 =	()	Item 8 =	()
Item 4 =	()	Item 9 =	()
Item 5 =	()	Item 10 =	()

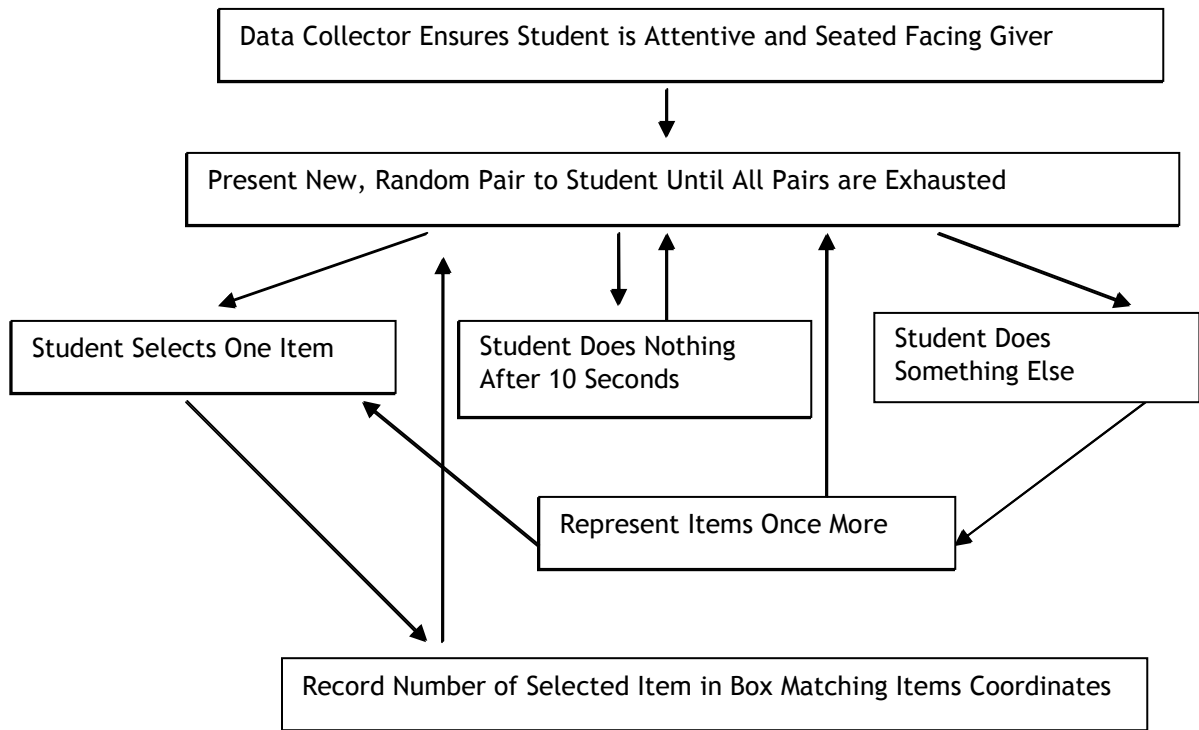
	1	2	3	4	5	6	7	8	9	10
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Appendix J

Teacher Instruction Manual- Preference Assessment Procedures

Teacher Instruction Manual Preference Assessment Procedures

- Schedule two different times on two different days to conduct the assessment
- Obtain all 10 preferred items and store out of student's sight but easily accessible
- Have a second person collect data and assist in keeping the student attentive
- Randomly select pairs of items to present to student, one in each hand, both equally centered to prevent any advantages in item selection
- If student selects one item, allow access until consumed (ounce or small bite) or about 15 seconds of engagement with a toy or object
- Score all items selected by writing their number in the square with coordinates matching the two items presented (or mark an "X" if neither item was selected)
- If student tries to take both items, quickly remove and represent items
- If student does not respond, remove items and choose the next random pair



Appendix K

Fine Motor Imitation Skills Assessment

Hand Fine Motor Imitation Data Sheet

Student: _____ Date: _____ Setting: _____
 Observer: _____ Session: _____ Interobserver agreement: Y / N

Hand Fine Motor Movement	Correct	Partial	Incorrect/ No Response
Touch thumbs together and hold			
Touch thumbs together and bounce			
Touch index fingers together and hold			
Touch index fingers together and bounce			
Touch palm to back of other hand and tap			
Touch palm to back of other hand and bounce			
Touch palm to back of other hand and hold			
Touch finger to back of other hand and tap			
Touch finger to back of other hand and bounce			
Touch finger to back of other hand and hold			
Index finger draws line (left to right) on table			
Index finger draws line (towards self) on table			
Index finger draws line (away from self) on table			
Index finger bounce on thumb (pincer grip)			
Index finger held closed on thumb (pincer grip)			
Bent arms, elbows at waist, arms out in front and fists together (ASI sign for "shoe")			
Bent arms, elbows at waist, arms out in front and fists apart			
Bent arms, elbows at waist, arms out in front, fists apart and palms up			
Bent arms, elbows at waist, arms out in front, fists apart and palms down			
Bent arms, elbows at waist, arms out in front, fists apart and palms up			
Bent arms, elbows at waist, arms out in front, and spread fingers			
Bent arms, elbows at waist, arms out in front, and spread fingers, then do fist, etc.			
Fold hands (fingers interwoven)			
Wave with hand, up & down			
Wave with hand, side to side			
Bent arms, elbows at waist, arms out in front, fist moves up and down (pound table)			
Bent arms, elbows at waist, arms out in front, fist moves up and down (ketchup bottle)			

Appendix L

Teacher Instruction Manual- Assignment of Targets Procedures

Teacher Instruction Manual- Assignment of Targets Procedures

- Tally the amount of times each item was selected by counting the corresponding numbers recorded in the grid
- For each category, separate the items and rank them from highest to lowest
- Randomly assign picture intervention and manual sign intervention as first or second intervention
- Starting with the category possessing the highest remaining pair of items, assign the highest item to the first intervention and the second highest item to the second intervention
- Assign the third highest item to the second intervention and the fourth highest item to the first intervention
- Assign the fifth highest item to the first intervention and the sixth highest item to the second intervention
- If there is a tie between remaining items in two categories, select items based on the highest pair of items in a category and then by novelty of category
- If there is a tie between two items in one category, try to pair items based on characteristics (sweet, salty, crunchy, chewy, noise, lights, etc...)

<u>Food</u>	<u>Drink</u>	<u>Toy</u>
Cookie (7)	Apple Juice (5)	Car (4)
Skittle (5)*	Iced Tea (3)	String (3)
Cracker (5)**	Water (1)	
M&M (4)	Milk (1)	

<u>Picture Intervention (1st)</u>	<u>Manual Sign Intervention (2nd)</u>
Cookie	Cracker
M&M	Skittle
Iced Tea	Apple Juice

* Skittle was paired with M&M as a better match (crunchy and sweet) than with cracker

** Tie between Cracker and Apple Juice broken by higher pair of food items vs. drinks

Appendix M
Baseline Procedures Checklist

Baseline Procedures Checklist

Picture Targets

Date:

Completed by:

- _____ Giver attempted to entice participant with all items
- _____ Items were presented randomly
- _____ Each item was presented at least three times
- _____ The communication book was out with all pictures inside
- _____ Successful communication attempts resulted in immediate delivery of item WITHOUT ITS LABEL OR A MAND MODEL
- _____ Other communication attempts were delayed for 5-10 seconds before delivery of item WITHOUT ITS LABEL OR A MAND MODEL
- _____ The student is allowed access to the object for approximately 15 seconds before it is either consumed or removed
- _____ No prompting was done to encourage use of manual sign, pictures, or vocals

Manual Sign Targets

Date:

Completed by:

- _____ Giver attempted to entice participant with all items
- _____ Items were presented randomly
- _____ Each item was presented at least three times
- _____ The communication book was put away for manual sign targets
- _____ Successful communication attempts resulted in immediate delivery of item WITHOUT ITS LABEL OR A MAND MODEL
- _____ Other communication attempts were delayed for 5 seconds before delivery of item WITHOUT ITS LABEL OR A MAND MODEL
- _____ The student is allowed access to the object for approximately 15 seconds before it is either consumed or removed
- _____ No prompting was done to encourage use of manual sign, pictures, or vocals

Appendix N
Picture Intervention Checklist

Picture Intervention Checklist

Date:

Completed by:

- _____ Trainers positioned appropriately (Giver across, Prompter behind/beside)
- _____ All items were validated prior to instruction (unless requested spontaneously)
- _____ All instruction trials preceded by student initiation

Giver

- _____ Giver entices student with both items
- _____ If student does not initiate, validation trial for the next item is started
- _____ Items were presented randomly
- _____ Each item was presented for 5-10 trials unless discontinue criteria met
- _____ First instruction trial for each target in each session incorporated a discrimination probe
- _____ Discrimination probe with Giver offering both preferred items from validation trial and saying "take it"
- _____ Giver does not allow student to take non-corresponding item
- _____ Upon delivery of the picture icon, the Giver immediately delivered the item while labeling it and modeling the mand form (within two seconds)
- _____ Giver refrains from additional language (e.g., that's right, correct, good job)
- _____ The student is allowed access to the object for approximately 15 seconds before it is either consumed or removed
- _____ Giver refrains from prompting the student
- _____ Pictures corresponding to validation trial appear on front of communication book
- _____ Giver moves pictures around on book (diagonal, vertical, horizontal)
- _____ No verbal prompting
- _____ Giver returns picture while student consumes/plays with reinforcer

Prompter

- _____ Prompter, following student initiation, immediately uses least intrusive prompt procedure to select and deliver picture icon
- _____ Prompter assists student, if needed, to take corresponding item

- _____ Prompter fades prompts effectively (decrease prompt after at least three consecutive requests at a given prompt level)
- _____ Following a student error, the trial is immediately terminated and restarted
- _____ Following an error, the Prompter reverts to the previous level of prompting
- _____ Prompter interrupts/prevents student's interfering behaviors
- _____ Prompter does not socially interact with student

Appendix O

Manual Sign Intervention Checklist

Manual Sign Intervention Checklist

Date:

Completed by:

- _____ Trainers positioned appropriately (Giver across, Prompter behind/beside)
- _____ All items were validated prior to instruction trial sequences
- _____ All instruction trials preceded by student initiation
- _____ If the student chronically struggles to perform a manual sign independently, a modified approximation is agreed upon and set as the new expectation

Giver

- _____ Giver entices student with both items
- _____ Items were presented randomly
- _____ Each item was presented for 5-10 trials unless discontinue criteria are met
- _____ First instruction trial for each target in each session incorporated a discrimination probe
- _____ Discrimination probe with Giver offering both preferred items from validation trial and saying "take it"
- _____ Giver does not allow student to take non-corresponding item
- _____ Upon performance of the manual sign, the Giver immediately delivered the item while labeling it and modeling the mand form (within two seconds)
- _____ Giver refrains from additional language (e.g., that's right, correct, good job)
- _____ The student is allowed access to the object for approximately 15 seconds before it is either consumed or removed
- _____ The Giver refrained from prompting the student
- _____ If student does not initiate, validation trial for the next item was started
- _____ No verbal prompting

Prompter

- _____ Prompter, following student initiation, immediately uses least intrusive prompt procedure to complete the manual sign
- _____ Prompter assists student, if needed, to take corresponding item

- _____ Prompter fades prompts effectively (decrease prompt after at least three consecutive requests at a given prompt level)
- _____ Following a student error, the trial is immediately terminated and restarted
- _____ Following an error, the Prompter reverts to the previous level of prompting
- _____ Prompter interrupts/prevents student's interfering behaviors
- _____ Prompter does not socially interact with student

Appendix P
Generalization Probe Checklist

Generalization Probe Checklist

Date:

Completed by:

Generalization Probes- General Procedures

- ___ Probes are conducted during the first week of intervention and then temporarily ceased
- ___ Probes are started when mastery criteria for an independent request is reached in either training
- ___ Each person and setting generalization probe incorporates a spontaneity probe (with same procedures) and is conducted once per week
- ___ Probes are conducted prior to the corresponding training

Spontaneity Probes

- ___ No prompts are provided to assist the student to request
- ___ Targets are out of sight and Giver does not cue the student to request items
- ___ Communication book should be out with icons covered only for picture intervention
- ___ Probe ends when 20 seconds elapse without a student request
- ___ If the student does request an item, immediately delivery and label the item
- ___ Student only has opportunity to access one of each item
- ___ Probes are continued for any remaining targets following consumption of spontaneously requested item

Person/Setting Probes

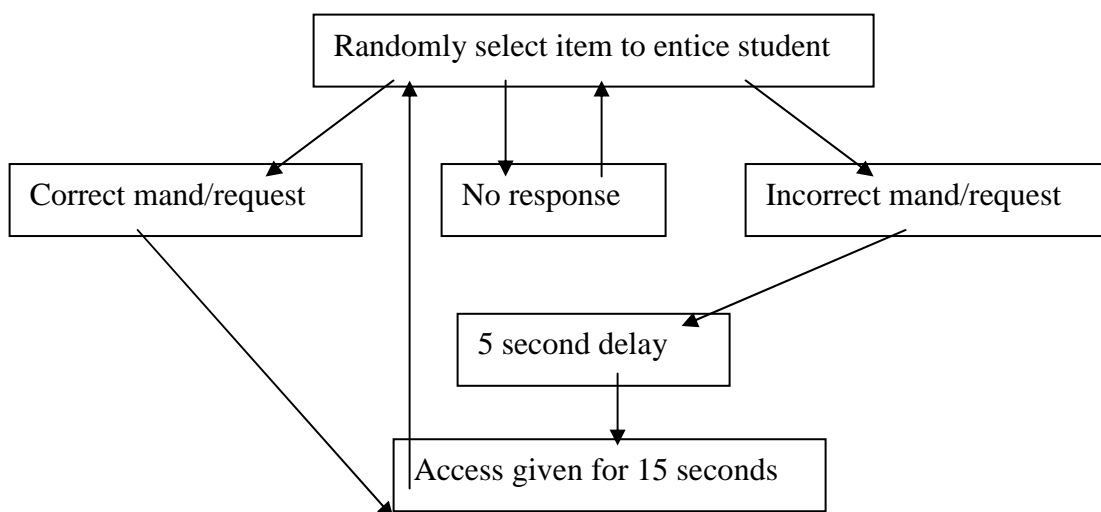
- ___ Once the spontaneous probe ends, any remaining targets are presented, one at a time, by the Giver to entice the student to request for up to 10 seconds per item
- ___ No prompts are provided to assist the student to request
- ___ If no request is made, the next item is presented until all items are exhausted
- ___ Independent requests result in immediate delivery and label of item

Appendix Q

Teacher Instruction Manual- Baseline Procedures

Teacher Instruction Manual- Baseline Procedures (manual sign and picture intervention)

- Giver sits across from or student
- Items are presented randomly to entice student, out of reach, one at a time, until all items were presented three times
- The communication book is out with all pictures inside for communication targets
- The communication book is put away for manual sign targets
- Successful communication attempts result in immediate delivery of item WITHOUT ITS LABEL OR A MAND MODEL
- Other communication attempts are delayed for 5 seconds before delivery of item WITHOUT ITS LABEL OR A MAND MODEL
- Allowed access to the object for approximately 15 seconds before it is either consumed or removed
- Do not prompt student or encourage use of manual sign, pictures, or vocals



Appendix R

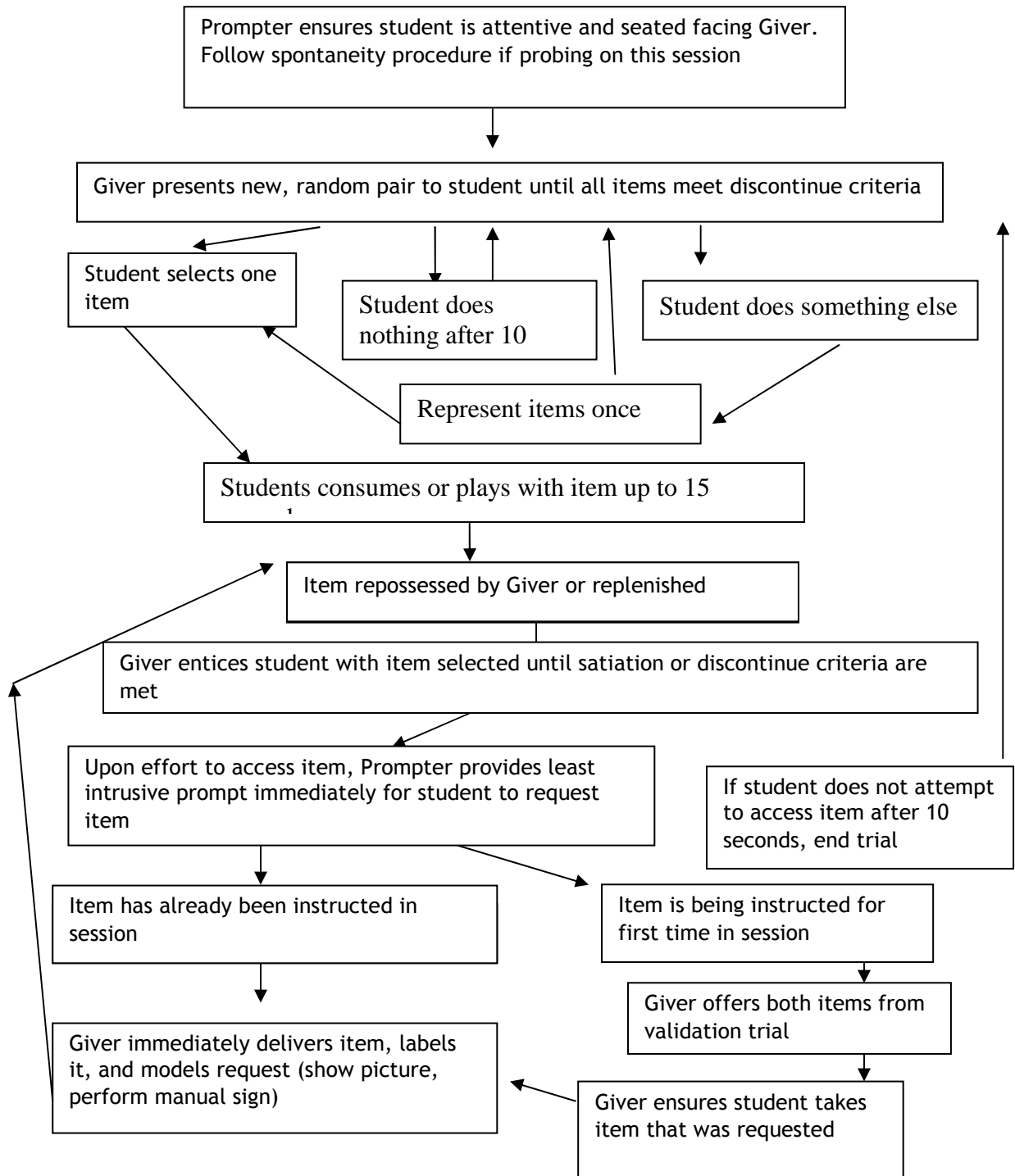
Teacher Instruction Manual- Intervention Procedures

Teacher Instruction Manual- Intervention Procedures

- Giver sits across from student, prompter next to or behind
- All items are present but out of sight
- During the first week of intervention, generalization probes are conducted and then ceased
 - a. For Picture Intervention, the communication book is out but is not directly in front of the student and the icons are covered
 - b. For Sign Intervention, the communication book is unavailable and out of sight
- Items spontaneously requested are immediately given with a vocal label
- Spontaneity probe continues until all items are requested or until 20 seconds elapses without a request
- During all intervention (except when generalization probes are conducted), the communication book is open with icons for picture items
- Randomly select a pair of items and entice student, allowing access to one item for 15 seconds or until consumed. This is a **validation trial** and should be done to start the session and anytime an item is discontinued (you have taught at least five trials or the student no longer wants the item).
- Instruction trials involve enticing the student with the “validated” item that was just chosen. At the first attempt to get the item, the prompter provides the least intrusive prompt (starting with full physical, then partial physical, than independent) to assist the student in requesting the item.
- The Giver performs a discrimination probe only for the first trial of each item in the session. Following the request (prompted or independent), the Giver offers both items from the preceding validation trial and ensures the student takes correct item (allow student to be correct but quickly assist if student reaches for incorrect item)
- For all other instruction trials, following the student’s request (prompted or independent), the Giver will immediately deliver the item, label the item, and model the correct request for the item (show picture icon or perform manual sign)

- Giver replenishes items and returns picture icons while items are consumed (up to 15 seconds)
- If student does not attempt to get an item or otherwise shows disinterest, end instruction on the item and start another validation trial

Teacher Instruction Manual- Intervention Procedures



Appendix S

Teacher Instruction Manual- Generalization Probes

Teacher Instruction Manual- Generalization Probe Checklist

Generalization Probes- General Procedures

- Probes are conducted during the first week of intervention and then ceased until mastery criteria for an independent request is reached in either training
- Each person and setting generalization probe incorporates a spontaneity probe (with same procedures) and is conducted once per week
- Probes are conducted prior to the corresponding training

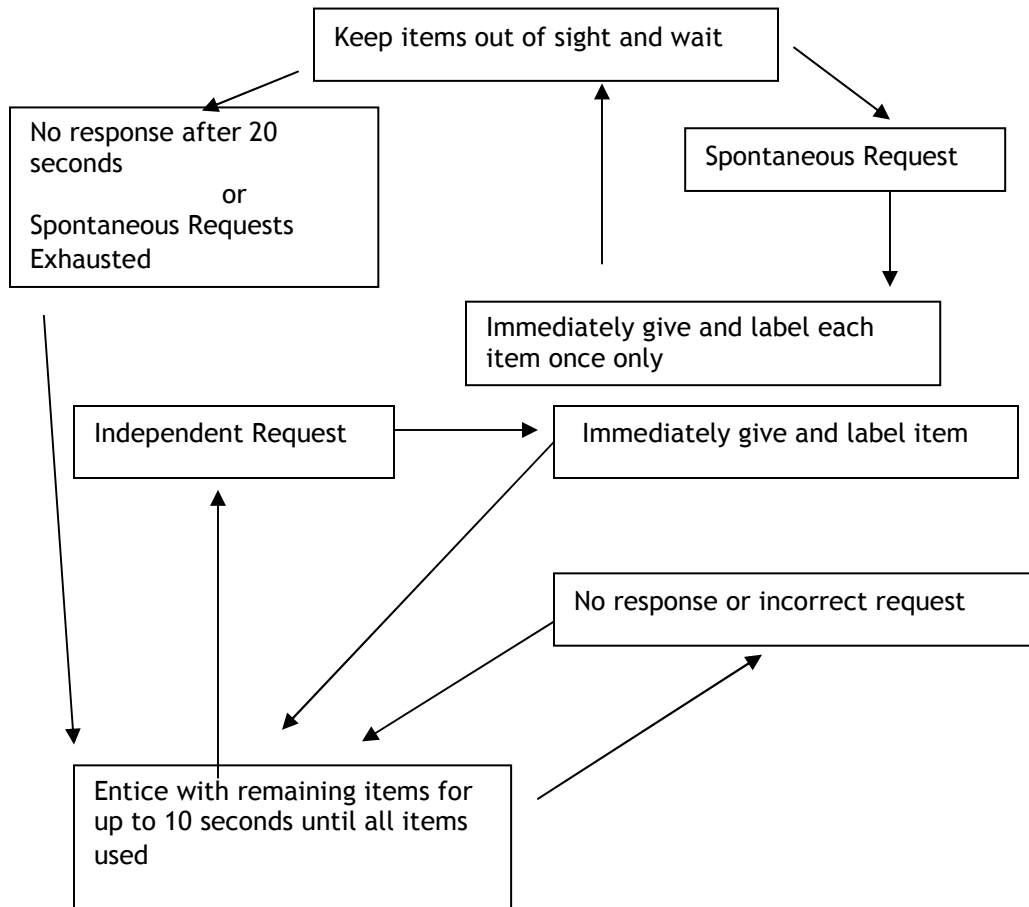
Spontaneity Probes

- No prompts are provided to assist the student to request
- Targets are out of sight and Giver does not cue the student to request items
- Communication book should be out with icons covered only for picture intervention
- Probe ends when 20 seconds elapse without a student request
- If the student does request an item, immediately delivery and label the item
- Student only has opportunity to access one of each item
- Probes are continued for any remaining targets following consumption of spontaneously requested item

Person/Setting Probes

- Once the spontaneous probe ends, any remaining targets are presented, one at a time, by the Giver to entice the student to request for up to 10 seconds per item
- No prompts are provided to assist the student to request
- If no request is made, the next item is presented until all items are exhausted
- Independent requests result in immediate delivery and label of item

Teacher Instruction Manual- Generalization Probe Flow Chart



Appendix T
Social Validity Questionnaire

Social Validity Questionnaire

1. Describe the amount of effort required of you in this study.
2. Do you think you were able to implement the interventions adequately?
3. Did you receive adequate support in implementing the interventions during this study?
4. Were the interventions effective? Did your student respond better to one strategy?
5. Did this study provide professional benefits for you? Explain
6. What did you like most about this study? What did you like least about this study?
7. What suggestions would you make for improving this study?
8. Would you participate in a study like this again?
9. Please add any other comments.

Daniel B. Curtis**Current Work Contact:**

Carbon Lehigh Intermediate Unit
 610-769-4111 x1642
 curtisd@cliu.org

Personal Contact Information

danbricurt@yahoo.com

Education

2003-2012	Doctoral Program in School Psychology	Lehigh University
2000-2003	Master's Degree Human Development	Lehigh University
1991-1995	Psychology, B.S. Quantification Option	Pennsylvania State University

Certifications and Relevant Training

2004-2012	Pennsylvania Certified School Psychologist
2008	PECS Two Day Basic Training
2001-2002	Sub-specialization in Low Incidence Disabilities

Professional Affiliations

National Association of School Psychologists
 American Psychological Association
 Multiple Disabilities Behavioral Committee (CLIU 21)

Research and Research Experience

Curtis, D. B. (2004). The use of collaborative problem solving consultation to facilitate the inclusion of students with low incidence disabilities. Qualifying Project: Lehigh University.

Research Assistant 1995-1996 Language and Cognition Lab University Park, PA

- Acquiring Dutch Vocabulary: The effects of learning new vocabulary through words and pictures in (non) categorized groups on recall and recognition.
- The Effects of Context and Modality on 2nd Language Acquisition

Practitioner Experience

2006-2012	Behavior Specialist Consultant	Carbon-Lehigh Intermediate Unit
2004-2012	Certified School Psychologist	Carbon Lehigh Intermediate Unit
2002-2005	Project Supervisor	Low Incidence Disabilities Grant- Lehigh University
2001-2002	Project Trainee	Low Incidence Disabilities Grant-Lehigh University
2000-2001	Program Manager	Lehigh Support for Community Living
1998-2000	Therapeutic Support Staff	Maternal Childcare Consortium

National Presentations

- Curtis, D. B. & Kunsch, C. (2005). Training *School Psychologists to Servicer Students with Low-Incidence Disabilities*. American Psychological Association: Washington, D.C. August, 2005 Washington Convention Center
- Curtis, D. B. & Nelson, J. (2004). Training *School Psychologists as Inclusion Facilitators for Students with Low-Incidence Disabilities*. National Association of School Psychologists Conference Dallas, TX April, 2004 Adam's Mark Conference Center
- Curtis, D. B., Nelson, J. & Clemens, N. (2003). Training *School Psychologists as Inclusion Facilitators for Students with Low-Incidence Disabilities*. The 37th Annual Pennsylvania School Psychologists Conference. October, 2003. Pennsylvania State University State College, PA
- Stacy, R. & Curtis, D. B. (March, 1996). *The Effects of Context and Modality on 2nd Language Acquisition*. APA- Psi Chi Poster session at Adam's Mark Hotel in Philadelphia, PA.

Professional Development Presentations

- Curtis, D. B. Understanding Behavior for Instructional Decision Making (August 15, 2007). Presented for Act 48 hours to education professionals at the Carbon-Lehigh Intermediate Unit, Schnecksville, PA.
- Curtis, D. B. Communication Options for Individual Students (August 17, 2007). Presented for Act 48 hours to education professionals at the Carbon-Lehigh Intermediate Unit, Schnecksville, PA.
- Curtis, D. B. Understanding Behavior for Instructional Decision Making: Part 2 (October 8, 2007). Presented for Act 48 hours to education professionals at the Carbon-Lehigh Intermediate Unit, Schnecksville, PA.
- Curtis, D. B., Krebs, N., Kunkle, J. & Newton, K. Effective Components of an IEP in an MDS-B Classroom (August 15, 2008). Presented for Act 48 hours to education professionals at the Carbon-Lehigh Intermediate Unit, Schnecksville, PA.
- Data Collection and Making Data-Based Decisions (August 21, 2009). Presented for Act 48 hours to education professionals at the Carbon-Lehigh Intermediate Unit, Schnecksville, PA.
- Curtis, D. B. Life Skills Networking Managing Behaviors and Basic Data Collection Tools. (June 30, 2010 – July 1, 2010). Presented for Act 48 hours to education professionals at the Carbon-Lehigh Intermediate Unit, Schnecksville, PA.
- Curtis, D. B. Managing Behavior Programs and Skills Useful to the Autism Interventionist Role (August 25, 2011). Presented to the Enhanced Autism Program staff at the Carbon-Lehigh Intermediate Unit, Palmerton, PA.
- Curtis, D. B. Using the Functional Behavior Assessment Data Tool (February, 3, 2012). Presented to regional school psychologists at the Carbon-Lehigh Intermediate Unit, Schnecksville, PA.