COMPAIRING PICTURE EXCHANGE AND VOICE OUTPUT COMMUNICATION AIDS IN YOUNG CHILDREN WITH AUTISM

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ABSTRACT

The Center for Disease Control estimates that one in 88 births result in a diagnosis of autism (CDC, 2012). Of those individuals diagnosed with autism approximately 25-61% fail to develop vocal output capabilities (Weitxz, Dexter, & Moore, 1997). The use of Augmentative and Alternative Communication (AAC) systems, such as Picture Exchange (PE) and Voice Output Communication Aids (VOCA) has been demonstrated as effective for those individuals to acquire a mand repertoire (Mirenda, 2003). The focus of the current study was to compare mand acquisition using PE and the iPad as a VOCA, in terms of acquisition rate and participant device preference, and with regard to collateral effects on vocalizations and disruptive behaviors. Additionally, the study evaluated the effectiveness of a teaching strategy using constant time delay with full-physical prompts (Sigafoos, Doss, & Reichel, 1989) in the acquisition of a mand repertoire using PE and the iPad as a VOCA, in five preschool aged children with autism. Finally, the devices were assessed in terms of their social validity. Three participants acquired the ability to communicate using the iPad as a VOCA more readily and two participants acquired the ability to communicate more quickly using PE, while the overall rate of independent manding was higher for four participants using the VOCA. The results of the study also indicate that the use of a constant time delay procedure with full-physical prompts was effective in the acquisition of both PE and the VOCA device. Regarding preference, four participants demonstrated a clear preference for the VOCA device and one for PE, when presented with the option to respond with either device. With respect to collateral effects, the data were largely inconclusive. For one participant there was an overall increase in vocalizations, for one participant there was an overall decrease in vocalizations, for the remaining three there was no systematic change in their rate of vocalizations during or following communication training. Regarding disruptive behaviors, an overall decrease in the occurrence was seen for two participants, for the remaining three the rates of occurrence did not change systematically following communication training. Finally, in terms of social validity, both the VOCA device and PE were found to be acceptable communication tools, with educators reporting that they would not only include such training within their classroom routines, but would also recommend its use in the future.

Descriptors: autism, mand, picture exchange, voice output communication aid, augmentative and alternative communication

DEDICATION

For my father….

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CHAPTER 1
INTRODUCTION

Currently, the Center for Disease Control estimates that approximately one in 88 births results in a diagnosis of autism (CDC, 2012). Intervention strategies based on the methodology of applied behavior analysis (ABA) have been demonstrated as effective in the education and treatment of individuals diagnosed with autism (National Research Council, 2001). Within the domain of ABA, the development of a functional communication repertoire, or mand repertoire, is seen as a pivotal skill and incorporated into many instructional sequences (e.g., Koegel & Koegel, 2006; Lovaas, 1981, 2003; Maurice, Green, & Foxx, 2001).

It is also estimated that approximately 25-61% of individuals diagnosed with autism fail to develop vocal output capabilities (Weitz, Dexter, & Moore, 1997). Given the prevalence of both autism and of those individuals diagnosed with autism who fail to naturally develop speech, the use of Augmentative and Alternative Communication (AAC) has received much attention within the literature of special education, ABA, and that of speech and language pathology. AAC systems are generally divided into two categories: unaided systems that do not require any equipment, and aided, which require the use of a device (Mirenda, 2003).

The use of both picture exchange (PE) and Voice Output Communication Aids (VOCA) as AAC strategies has been largely validated in the literature (e.g., Dicarlo &

Banajee, 2000; Ganz & Simpson, 2004; Sigafoos, 2009; Yoder & Lieberman, 2010). Additionally, although generally inconclusive, the literature has offered comparison studies of PE and VOCA devices in the acquisition of mand repertoires by individuals' with disabilities (e.g., Beck, Stoner, & Parton, 2008; Sigafoos, 2009). However, given recent technological advances in the development and availability of hand-held computing devices such as the iPad and applications such as Proloqu2Go, which provides communication capabilities comparable to traditional VOCA, the topic of PE and VOCA warrants further consideration. Specifically, few if any peer reviewed studies have compared PE with iPad based software programs for teaching AAC, including Proloqu2Go.

The focus of the dissertation reviewed here was an evaluation of a teaching strategy that used full-physical prompts on the acquisition of a mand repertoire using both PE and the iPad as a VOCA. Additionally a comparison of PE and the iPad as a VOCA, in the development of a mand repertoire in five preschool-aged children diagnosed with autism was investigated. Finally, the collateral effects of mand training, using both PE and the iPad as a VOCA, were investigated in terms of disruptive behavior and vocal utterances.

Research Questions

1) What are the effects of a teaching procedure using full-physical prompting using the iPad with the application Proloqu2Go on the acquisition of a mand repertoire by students with autism?

2) What are the effects of a teaching procedure using full-physical prompting using Picture Exchange (PE) on the acquisition of a mand repertoire by students with autism?

3) Which device, the iPad with the application Proloqu2Go or PE, produces more

independent manding for students with autism?

4) Will students display a preference for either device when given the opportunity to respond with either?

5) What are the effects of the use of the iPad and application Proloqu2Go, and PE on collateral behaviors such as vocalizations and disruptive behaviors?

6) Which device will the participants demonstrate preference for, when provided with the opportunity to respond with either device?

To answer these questions, five participants aged four-to-six-years were exposed to a training procedure across both PE and the iPad as a VOCA, which used full-physical prompts. Data were collected on (a) independent mands, (b) vocalizations, and (c) disruptive behavior. Additionally all staff who worked in the classroom in which the participants received instruction were asked to complete an eight-question social validity survey. The training procedures will be described in Chapter 3 and the results of these training procedures will be presented in Chapter 4 and discussed in Chapter 5.

CHAPTER 2
REVIEW OF THE LITERATURE

Autistic Spectrum Disorder

Autistic Spectrum Disorder (ASD) is a developmental disorder of neurobiological origin with behavioral manifestations (National Research Council, 2001). In accordance with the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revised* (DSM-IV-TR; American Psychiatric Association, 2004), ASD is characterized by impairments or excesses in three behavioral domains: communication, socialization, and restricted interests and stereotyped patterns of behavior. ASD is considered a spectrum given the heterogeneous nature of the severity and symptoms, age of onset, and co-morbidity of disorders such as intellectual disability, epilepsy, attention deficit disorder, etc. (Flippin, Reszka, & Watosn, 2010). Included in this spectrum are Autism, Asperger's Disorder, and Pervasive Developmental Disorder-Not Otherwise Specified (American Psychiatric Association, 2004). Currently the Center for Disease Control estimates that between one in 88 results in a diagnosis of ASD (CDC, 2012).

Intervention strategies based on the methodology of Applied Behavior Analysis (ABA) are prevalent within ASD education (Maurice, Green, & Luce, 1996; Pelios & Lund, 2001; National Research Council, 2001). Within the ABA literature, functional communication, particularly the mand repertoire is described as an essential skill to be taught within comprehensive programs (Cooper, Heward, & Heron, 2007 p. 530). However, approximately 25-61% of individuals diagnosed with ASD do not acquire functional speech naturally (Flippin et al*.,* 2004; Weitz, Dexter, & Moore, 1997). Given the prevalence of individuals diagnosed with ASD who fail to develop functional speech, the development of a functional communication repertoire is seen as a pivotal skill and is commonly incorporated into ABA curricular sequences (Koegel & Koegel, 2006; Lovaas, 1981, 2003; Maurice, Green, & Foxx, 2001; Partington, 2006; Sundberg & Partington, 1998; Sundberg, 2007). Skinner (1957) first described the mand as a verbal operant under the control of a condition of deprivation or aversive stimulation. Skinner (1957) further asserted that the mand is the only verbal operant that directly benefits the speaker, as when the speaker is "manding" he specifies the reinforcer, which is then delivered directly by his listener.

In the absence of a vocal mand repertoire, many individuals diagnosed with ASD rely on pre-linguistic behaviors such as pointing, gesturing, reaching, eye gaze, and facial expressions to communicate their wants and needs (Lancioni, O'Reilly, Cuvi, Singh, Sigafoos, & Didden, 2007). In conjunction with or in place of these pre-linguistic behaviors, these individuals may develop adaptive disruptive behaviors (i.e., aggression, self-injury, and property destruction) as a functional yet undesirable means of having their wants and needs met (Carr & Durand, 1985). For example, an individual may engage in aggression if he or she is hungry and lacks the ability to appropriately request access to food.

Given the rates of individuals diagnosed with ASD who fail to develop adequate vocal speech, it is often necessary to incorporate the use of an augmentative and alternative communication (AAC) system when establishing a functional communication or mand repertoire (Millar, Light, & Schlosser, 2006; Mirenda, 2003 & 2001; Ogletree & Harn, 2001; National Research Council, 2004).

Augmentative and Alternative Communication

AAC systems can be used to either supplement (i.e., augment) limited speech or act as the primary (i.e., alternative) method of communication (Mirenda, 2003 & 2001; Ogletree & Harn, 2001; National Research Council, 2004; Millar, Light, & Schlosser, 2006). The overarching goal of AAC is the development of generalized and functional communication within the natural environment throughout the lifetime of the individual (Mirenda, 2003). The use of AAC to establish a communicative repertoire for individuals diagnosed with ASD has been noted in the literature since the 1970's and is currently viewed as an independent field (Ogletree & Harn, 2001). Furthermore, the benefits of AAC in the enhancement of a communicative repertoire are generally well recognized within the literature (Millar, Light, & Schlosser, 2006; Mirenda 2003 & 2001; Schlosser & Wendt, 2008).

Within the domain of AAC, two broad categories exist, aided and unaided (Mirenda, 2003). Unaided communication is categorized as such because it does not require any equipment and includes manual signs and gestures (Mirenda, 2003). Aided AAC includes the Picture Exchange Communication System (PECS); Frost & Bondy, 2002,other forms of picture exchange (PE) communication (Mieranda, 2003), and voice-output communication aids (VOCA). PECS and PE rely on the selection and exchange of a picture, depicting the requested item or activity as the mode of communication (Michael, 1985). VOCA are electronic devices that rely on the speaker's pressing of a picture depicting the requested item or activity on an electronic screen with enough force to evoke a digitized vocal message (Lancioni et al., 2007). For example, if an individual desires a cookie, he or she would press a picture of a cookie on the touch screen of the electronic device that would produce the digitized output “I want cookie”.

Unaided Augmentative and Alternative Communication Systems

Empirical support for the use of unaided AAC (e.g., sign language) is indicated in the literature. Kouri (1988) demonstrated the effectiveness of sign language in the acquisition of a communication repertoire in five preschoolers diagnosed with autism, using an ABAB withdrawal design. The results of the study indicated that the use of sign language was effective in the acquisition of a communicative repertoire, utilizing a child-directed instructional technique (i.e., Natural Environment Teaching). Furthermore, the training resulted in an increase in speech production in all five participants. Carr, Binkoff, Kologinsky, and Eddy (1978) also demonstrated the effectiveness of sign language training in the acquisition of a communication repertoire in four children diagnosed with autism. Using a multiple-baseline across objects design, they showed that all four participants successfully acquired the ability to sign for five different food items. The researchers used procedures that included prompting, fading, and stimulus rotation (Carr, Binkoff, Kologinsky, & Eddy, 1978). Research investigating sign language has also focused on teaching signs paired with speech to yield a method referred to as “total communication” (Yoder & Layton, 1988). The use of total communication has proved to be more effective, in terms of acquisition rate and generalization, than sign alone (Barrera, Lobatos-Barrera, & Sulzer-Azaroff, 1980; Brady & Smouse, 1978; Yoder & Layton, 1988).

Although the use of sign language and total communication has empirical support regarding its effectiveness in the establishment of a communicative repertoire, there are several limitations to its use when compared to aided AAC. One limitation is a reliance on the listener's knowledge within the natural environment. For example, a clerk at a store and a server at a restaurant may not possess knowledge of sign language (Bondy & Frost, 1994; Mirenda, 2003). An additional limitation of the use of unaided AAC is that individuals with autism and related developmental disabilities often demonstrate motor impairments and have difficulty with imitative skills, which can limit their ability to acquire unaided AAC (Bondy & Frost, 1994; Mirenda, 2003; Seal & Bonvillian, 1997). Finally, unaided AAC requires that the learner acquire many responses that are topographically dissimilar, whereas aided AAC require that the learner only acquire one response topography, such as pointing to or exchanging a picture symbol (Bondy, Tincani, & Frost, 2004).

Tincani (2004) highlighted the latter limitation by comparing the effectiveness of sign language and aided AAC (PECS) in terms of acquisition rates, in two school-aged children with ASD, using an alternating treatment design. The study was conducted within the participants' classroom and assessed motor imitation, mands, and vocalizations. Results of the study indicated that one learner who had poor imitation skills acquired sign language less proficiently than aided AAC, specifically, PECS..

Picture Exchange (PE) and Picture Exchange Communication System (PECS)

The PECS system was developed by Bondy and Frost (1994) and entails what is currently a six-phase training sequence (Frost & Bondy, 2002). As such, if the training protocol does not follow their outlined six-phase sequence, the communication strategy should be classified as PE (Lancioni et al., 2007). Phase I of the training protocol focuses on *the physical exchange*. During this phase the speaker acquires the ability to exchange a picture depicting an item or activity with the listener who in exchange provides the speaker with the item or activity depicted in the picture. This phase requires two trainers to be present, one assuming the role of the listener and the other the role of the trainer who facilitates this acquisition through the prompting of responding. Phase II, called *expanding spontaneity,* requires the speaker to travel a progressively increasing distance from the communication book to their listener. Placement of the picture of the desired item is varied, and generalization across speakers and contexts is targeted (Flippin et al., 2010). During phase III, *picture discrimination,* the speaker acquires the ability to discriminate between pictures, which vary in location within and on the cover of the communication book. Phase IV, referred to as *sentence structure,* requires the speaker to request desired items and activities using the sentence frame, “I want”. During this phase of training, a time delay procedure is introduced. During phase V, described as *responding to “What do you want?*”, the communication partner asks, “What do you want?” and the speaker acquires the ability to answer the question independently. Finally in phase VI, *responsive and spontaneous commenting*, the speaker acquires the ability to comment on environmental stimuli, through the use of carrier phrases such as, “I see” and “I have” and by providing responses to questions such as “What do you see?” and “What do you have?”, etc. . The effectiveness of PECS has been demonstrated in several studies including single-subject research designs, quasi-experimental group research designs, and randomized control studies (Flippin et al., 2010).

Yoder and Lieberman (2010) demonstrated the effectiveness of PECS in a randomized control study in which 36 participants between the ages of 18 and 60 months were randomly assigned to either the PECS protocol or Responsive Education and Prelinguistic Milieu

Teaching (RPMT). Nineteen participants were assigned to the PECS training and 17 to the RPMT training. Results of the investigation indicated that the participants that received PECS training acquired a larger number of picture exchanges than those who had received the RPMT training (Yoder & Lieberman, 2010).

Gordon and colleagues (2011) also investigated the effectiveness of PECS using a randomized control study. In their investigation, 84 children aged 4-10 were randomly assigned to three different treatment groups: immediate treatment, delayed treatment, and no treatment. Data were collected on spontaneous communication using picture cards and speech, spontaneous communication for requesting, and spontaneous requesting for social purposes. Results of the study indicated that those who received PECS training demonstrated increases in spontaneous communication using picture cards and speech and spontaneous communication for requesting, compared to those who did not receive training. Thus, the authors concluded that use of the PECS protocol enhanced the participants' ability to request using pictures.

Ganz and Simpson (2004) evaluated the effectiveness of PECS in three young children with autism. Using a changing criterion design, all three children acquired the ability to communicate using PECS. Interestingly, in this study the participants acquired the ability to communicate via PECS rapidly, requiring only an average of 5.7 sessions to master phase I, five sessions to master phase II, 7.3 sessions to master phase III, and five sessions to master phase IV.. Additionally, all three children demonstrated an increase in words spoken per trial; however, many of these words were described by the authors as unintelligible. Finally, all three participants demonstrated generalization of the acquired repertoire, manding for items across a variety of items and individuals (Ganz & Simpson, 2004).

As previously described, Tincani (2004) compared acquisition of a mand repertoire using PECS and sign language in two school-aged children with autism. Using an alternating-treatment design, the two participants received training in both PECS and sign language, with data collected on motor imitation, mands, and word vocalizations. The results of the study yielded mixed results. One participant acquired the ability to communicate using sign language more quickly than using PECS; however, this participant presented moderate hand-motor imitation skills prior to intervention. The second participant acquired the ability to communicate using PECS more quickly; this participant presented a limited ability to imitate hand-motor movements prior to intervention. Both participants demonstrated an increase in percentage of word vocalizations during training (Tincani, 2004).

Chambers and Rehfeldt (2003) also compared the effectiveness of PECS and sign language in four students diagnosed with autism and profound mental retardation. Using an alternating treatment design, all participants acquired the ability to commentate using PECS and sign language with comparable acquisition rates. Two of the participants demonstrated comparable generalization with both communication strategies, while one participant demonstrated better generalization with PECS. Finally, one participant did not demonstrate generalization of either PECS or sign language .

The mixed results of these studies underscore the heterogeneous needs of the ASD population. For individuals with sufficient motor imitation skills, the use of sign language may be an appropriate augmentative and alternative communication system. However, although the individual may be able to mand independently using sign language, the limitation of the listener's ability to interpret sign language remains a barrier to its use (Bondy & Frost, 1994; Mirenda, 2003). The differing topographies of responses required to acquire sign language should also be a consideration (Bondy, Tincani, & Frost, 2004). This suggests that further research is necessary to determine for whom PECS is a more appropriate method of AAC than unaided AAC.

Voice Output Communication Aids (VOCA)

The second category of aided augmentative and alternative communication systems are referred to as either Voice Output Communication Aids (VOCA) or Speech Generating Devices (SGD). VOCA are electronic devices that rely on the speaker's pressing of a picture depicting the desired item or activity on an electronic screen with enough force to evoke a digitized vocal message (Lancioni et al., 2007). VOCA differ from PECS or PE in that the speaker is not required to first gain the attention of his or her listener, prior to requesting an item or activity; therefore the listener is able to interpret the request even if he or she is not looking at or attending to the speaker (Lancioni et al., 2007).

Dozens of VOCA devices exist and range greatly in cost and technological capabilities (Lancioni et al., 2007). For example, the GoTalk Express 32 is a VOCA that contains 32 pre-programmed digitized outputs. The GoTalk Express 32 produced by Mayer-Johnson costs $599 according to its producers (http://www.mayer-johnson.com/gotalk-express-32/). The DynaVox Maestro possesses Wi-Fi capabilities allowing the individual to reprogram the device at any time, to include new items, provided that the device is within range of wireless internet access. According to its manufactures, the DynaVox Maestro costs

$175 dollars per week, with an annual cost of $9,100 (http://www.dynavoxtech.com/products/maestro/interaact/). Costs not withstanding, the use of VOCA has proven beneficial for individuals who do not demonstrate speech capabilities (Lancioni et al., 2007).

As previously mentioned, individuals with autism and related developmental disabilities may develop adaptive disruptive behaviors as a means of having their wants and needs met in the absence of a functional communication repertoire (Carr & Durand, 1985). Furthermore, individuals diagnosed with autism often demonstrate deficits in social interactions (Rapin, 1991). It has been demonstrated that VOCA training decreases disruptive behaviors (Durand, 1999) and increases social communication and initiation (Dicarlo & Banajee, 2000; Thunberg, Ashlsen, & Sandberg, 2007).

Dicarlo and Banajee (2000) investigated the effects of VOCA training on the occurrence of communicative behaviors of two children aged 24 and 28 months old and diagnosed with autism. Communicative behaviors were tracked for four months and were categorized as follows: (a) specific communicative behaviors; (b) unclear communicative behaviors; and (c) prompted communicative behaviors. Following VOCA training, both participants demonstrated an increase in specific communicative initiations and a decrease in unclear initiations. The results of the study suggest that communication training utilizing a VOCA can increase the rate at which an individual initiates communication.

Thunberg and colleagues (2007) investigated how VOCA training influences communication within the home environment with four boys (aged 5-7) diagnosed with autism, utilizing a pre-test/post-test multiple case study design. The activities selected by the parents for VOCA training included mealtime, story time, and the sharing of information about the preschool day. Following VOCA, training all four of the participant's responses increased; during the story-time condition, communication effectiveness increased; during the sharing information phase, communication effectiveness and communicative function increased for all participants. These results demonstrate that VOCA training can increase communicative function and/or the effectiveness of communication initiations within the home environment.

Sigafoos, Didden, and O'Reilly (2003) investigated the effects of communication training using VOCA on vocalizations. During this investigation three children diagnosed with autism (aged 3, 4, and 13) were taught to communicate using a VOCA. The dependent measures for this study included independent requesting and the frequency of vocalizations. Sigafoos and colleagues (2003) used a multiple-baseline across subjects design; therefore, training was not implemented until a stable baseline was evident. The training procedure was in place until each participant met a mastery criterion of 10 consecutive, unprompted responses. Visual analysis of these data indicated that there was no change in the frequency of vocalizations pre- and post-training; however, each of the participants acquired the ability to mand through use of VOCA.

Durand (1999) evaluated the effectiveness of VOCA training in decreasing problem behavior (i.e., self-injury, property destruction, aggression) maintained through positive and negative reinforcement in five children diagnosed with autism. Following a functional analysis that identified the function of the problem behavior, all five participants were taught to request a functional equivalent using a VOCA within four weeks of training. Incorporated into the research design was a generalization phase in which the acquired communicative skill was probed in a novel environment. Interval data were collected on the occurrence of problem behavior, with an interval duration of 3.5 minutes, from which rates of problem behavior were then calculated. The results of the investigation demonstrated that the acquired communicative repertoire was effective in decreasing the occurrence of problem behavior from a percent of 25-100 intervals to a percent of 0-5 intervals.

It is evident from the aforementioned studies that the use of VOCA is an effective means for increasing communicative behaviors and decreasing undesirable behaviors. Although the literature has reached some general consensus regarding positive benefits of VOCA on communication and challenging behavior, there is a lack of consensus regarding which instructional strategies should be used to establish a mand repertoire with the VOCA.

Schepis, Reid, Behrmann, and Sutton (1998) demonstrated the effectiveness of Natural Environment Teaching (NET) in the acquisition of a communication repertoire with a VOCA. In this investigation, four young children diagnosed with autism were taught to request a toy and/or an edible item within a naturally occurring routine (i.e., free play or snack time) and environment (i.e., a classroom). The training procedure entailed gestural and vocal prompting based on the assumption that physical prompting may lead to prompt-dependence. All four children demonstrated some independence in the requesting of a specific toy or edible item within one training session; thus, the authors assert that NET is a viable option for functional communication training. Additionally, Schepis et al. (1998) collected data on the frequency of vocalizations as a dependent measure within their research design. Visual analyses of these data also indicate that the use of VOCA did not decrease the use of other forms of communicative behaviors such as vocalizations and gestures.

Beck, Stoner, Bock, and Parton (2008) attempted to adapt the PECS protocol (Bondy & Frost, 1994) for use with a VOCA, while comparing acquisition rates of VOCA and PECS in four preschool children diagnosed with a developmental disability. For phase I of training the participant was required to exchange a 2X2 inch picture during PECS training. In the VOCA training condition, participants were taught to "grasp the handle of the VOCA lifting the top edge of a table" to activate the voice output during VOCA training. During phase II of VOCA and PECS training, the participant was required to travel six feet to a listener to communicate; however, a substantial confound was evident during this condition in that the participants were required to carry a large, bulky device in the VOCA condition, but they were only required to carry a 2X2 inch picture symbol in the PECS condition. For phase II training the participant was required to discriminate between two pictures on both the Velcro board and VOCA screen. Phases IV through VI of the PECS protocol were not included in the research design, as none of the participants progressed beyond phase three. None of the participants progressed past phase I training with the VOCA device. One participant never met mastery criteria for phase I in the PECS condition, two participants met mastery criteria for phase I, and one participant progressed through phase II.

Although all four of their participants acquired the ability to communicate using the adapted PECS protocol, Beck and colleagues (2008) investigation did not take into account the unequal response effort required for VOCA and PECS communication. When the participant was using the picture communication book in the PECS condition, he or she was required to remove a 2X2 inch picture from a Velcro board (phase I) and carry that picture six feet to a listener (phase II). When the participant was communicating using the VOCA, he or she was required to manipulate the device that required much greater response effort. For example, in phase I of VOCA training, the participants were required to “position the VOCA correctly by grasping the handle and accessing a picture to produce digitized speech”. For phase I of PECS training the participants were required to, “exchange a picture”. During phase II training, the participants were required to physically carry the VOCA device prior to the manipulations describe in phase I, whereas during PECS training he or she was required to only carry the picture (Beck et al., 2008). This difference in response effort casts doubt on the authors’ finding that PECS produced better response acquisition that VOCA, and also suggests that the PECS protocol (Bondy & Frost, 1994) is not applicable for communication training using a VOCA, at least not the type of VOCA used by Beck et al.

Additional studies investigating the acquisition of a communication repertoire have used a variety of training procedures. Examples of the training procedures include a most-to-least prompting hierarchy and fading techniques (Durand, 1999; Sigafoos, 2009); a least-to-most prompting hierarchy and shaping techniques (Sigafoos et al., 2003; Son et al., 2006); gestural and vocal prompting only (Schepis et al., 1998); and a physical prompting procedure (Sigafoos et al., 2004; Sigafoos, 2009). Within all of these studies, employing very different training procedures, all participants acquired a mand repertoire. This may be attributable to the heterogeneous nature of autism in that differing learner characteristics and preferences may indicate the need for different teaching techniques. For example, individuals who lack receptive language abilities or imitation skills may require physical prompting delivered via most-to-least prompt hierarchies, while learners who possess receptive language skills may benefit from vocal prompts.

Despite these different prompting techniques, one common trend in the literature is the use of edible items and a snack-time routine to teach communication (Dicarlo & Banajee, 2000; Sigafoos et al., 2009; Son et al., 2006). A limitation of this training procedure is that the communicative repertoire is not programmed for generalization. That is, the participants in these investigations were only taught to request one to three snack times. Additionally, the snack routine is only a small part of a student's natural schedule and to acquire functional communication the student must develop a mand vocabulary that extends to a variety of non-edible preferred items and activities. Additionally, the use of edible items for such training is more susceptible to satiation, as the teacher or clinician cannot always ensure that a student will be motivated by food. Furthermore, the withholding of food to ensure motivation may be viewed as unethical. Consequently, future research should focus on the use of non-edible items and additional classroom routines for communication training (e.g., withholding an item necessary to complete a behavioral chain) to make such training protocols more applicable to the applied setting and limit the effects of satiation.

The effectiveness of VOCA in the acquisition of a communicative repertoire is evident. The establishment of communication through the use of VOCA may decrease undesirable behaviors (Carr & Durand, 1985; Durand, 1999), and increased initiations for social interaction and other forms of communication (Dicarlo & Banajee, 2000; Thunberg et al., 2007). However given the costs of the devices, their availability, and the potential difficulties in programming the devices, additional factors must be considered when determining whether VOCA is an appropriate AAC (Lancioni et al., 2007).

Comparison of Picture Exchange and Voice Output Communication Aids

Bock, Stoner, Beck, Hanley, and Prochnow (2005) compared the acquisition rates and device preference in six four-year-old boys diagnosed with a developmental disability, using an alternating treatment design. Following a baseline period of seven days, Bock and colleagues implemented a three-phase teaching strategy over 5.5 weeks. The mastery criterion for progressing from one phase to the next was 90% independent responding, with identical phases for PECS and VOCA. Results of the investigation indicated that three children acquired PECS at a slightly faster rate. For the other three children, the VOCA and PECS were acquired at an identical rate. Regarding preference, the results were equally divided with three of the six participants demonstrating a slight preference for PECS and three of six children demonstrating a slight preference for VOCA. Finally, visual analysis of the data indicates that no independent responding occurred during baseline. With regard to VOCA training, none of the participants met mastery criteria for phase one. With regard to PECS training, one participant never progressed through phase one; two participants progressed through phase one; one participant progressed through phase two. The findings of this study replicated previous research suggesting that a communicative repertoire is acquired faster using PECS when compared to VOCA.

Sigafoos et al., (2009) also compared the acquisition of PE and VOCA by a 15-year-old adolescent diagnosed with Down Syndrome and autism. In the baseline phase independent responding occurred an average of 2.5 times across eight sessions. During training, the participant's independent responding reached the mastery criteria of five independent responses per session in six training sessions for both devices. Additionally, the participant demonstrated a slight preference for PE when given the option to use either device.

Son, Sigafoos, O'Reilly, and Lancioni (2006) used an alternating treatment design across three participants to compare the effectiveness of VOCA and PECS. Following training, all participants demonstrated the ability to request an item using both VOCA and PECS; however, fewer trials to the criterion of 75% were necessary for acquisition using the VOCA. Two of three of the participants demonstrated a preference for PECS when compared to VOCA.

These three studies present no conclusive data as to which method of aided AAC is superior. The availability of such data would provide practitioners and teachers with valuable information as to which AAC modality to select. Inconclusive results indicate that further replication is necessary to determine aided AAC is more effective. Additionally, none of these studies accounted for the difference in the response effort required to communicate using PECS or PE versus VOCA. When analyzing response effort, it is evident that these two methods of communication are unequal. The response topography required for PECS or PE entails the selection and exchange of a picture (Michael, 1985). The response topography required for VOCA except for the Beck et al., (2008) investigation, required only the pressing of a picture on a screen with enough force to evoke the digitized voice output (Lancioni et al., 2007). Thus, an additional requirement when using PECS or PE systems is gaining of the listener's attention, after the selection of and prior to the exchange of the picture depicting the requested item or activity. Future investigations comparing acquisition of PECS or PE and VOCA should minimize the unequal response effort, to the extent that the degree of effort is intrinsic given a specific modality. That is, when using a VOCA it is not necessary to carry the device to the listener, given that the listener is within range of the digitized output. Finally, with regard to the preference assessments, despite the generally conclusive results that the majority of participants preferred PECS or PE, the disregard of response effort and the failure to control for such confounds as hand dominance pose threats to the validity of these studies.

Conclusions

Given the prevalence of individuals with autism or a related developmental disorder who fail to naturally develop speech and/or functional communication repertoires, it is often necessary to use an augmentative or alternative communication device (AAC) to teach such individuals to communicate. Within the domain of AAC, there are two broad categories of devices: unaided communication systems (i.e., American Sign Language) and aided communication systems (i.e., PE and VOCA).

Comparisons of VOCA and PECS and/or PE have yielded mixed and/or inconclusive results. Bock et al., (2005) and Sigafoos et al., (2009) examined the acquisition rates of VOCA and PE training and found comparable acquisition rates. Son and colleagues (2006) found that VOCA training required fewer trials to criterion than PE training; however, Beck and colleagues (2008) found that PECS training progressed faster than VOCA when the PECS protocol outlined by Bondy and Frost (1994) was followed. As such, the research described has indicated that either VOCA or PECS/PE can be a viable option for functional communication training. However, practitioners often must choose between VOCA and PECS/PE systems; yet, the equivocal results found in previous studies leave them without evidence- based, specific support for the selecting of the most effective AAC device for a given individual.

With regard to preference, one study yielded mixed results and two others showed that participants preferred either VOCA or PE/PECS. Bock and colleagues (2005) found equal preference for both PECS and VOCA. Conversely, Son et al. (2006) and Sigafoos et al. (2009) both demonstrated a slight preference for PECS or PE when compared to VOCA. These results should be taken with caution given the lack of regard for response effort, in that it was intrinsically more effortful for participants to request with VOCA, and this likely lowered their rates of VOCA acquisition. Differential response effort required for each device is a clear threat to internal validity of the findings. As such, future replications should seek to equalize response efforts for each system or device.

When analyzing the effects of VOCA training on social behavior and decreasing inappropriate communication (e.g., aggression, self-injury), the literature is more consistent. Thunberg and colleagues (2007) found that following VOCA training, the participants demonstrated an increase in social communication within their home. Similarly, Sigafoos and colleagues (2004) and Dicarlo and Banajee (2000) demonstrated an increase in initiations for communications following VOCA training. Additionally, Schepis and colleagues (1998) and Sigafoos and colleagues (2004) found that following VOCA training, an increase in vocalizations was observed. Finally, Durand (1999) demonstrated that VOCA training leads to a decrease in problem behavior determined to function for positive reinforcement in the form of social attention or access to a tangible item or activity. However, despite the evidence that the use of an AAC device leads to an increase in social communication and a decrease in adaptive disruptive behavior, practitioners and teachers are not provided with any evidence-based guidelines for selecting one device versus another.

With regard to effective training procedures, the literature has not provided much consistent guidance for practitioners, with a variety of training procedures described as effective. Although Bondy and Frost (1994) have developed a detailed and effective protocol for PECS training, no such protocol exists for VOCA training. Schepis and colleagues (1998) provided clear guidance and support for the use of naturalistic training procedures and their effects on the development of a communication repertoire using VOCA. Although this training was effective, the research design did not include maintenance probes and thus should be interpreted with caution.

Researchers describe a variety teaching strategies which may or may not be compatible within a given device; these include the use of most-to-least (Durand, 1999; Sigafoos, 2009) versus least-to-most (Sigafoos et al., 2003; Son et al., 2006) and gestural prompting (Schepis et al., 1998) versus physical prompting (Sigafoos et al., 2004) strategies. For practitioners and teachers who are faced with the task of designing a training protocol for the acquisition of a communication repertoire, a more consistent literature would be helpful. Additionally, the common use of edible items and the snack time routine and the lack of programming for generalization within the literature leaves practitioners and teachers with little guidance.

Given the demonstrated effectiveness of communication training in increasing social communication (Thunberg et al. 2007; Sigafoos et. al. 2003; Dicarlo & Banajee 2000; Sigafoos et al. 2004) and decreasing problem behavior (Durand, 1999), more replications comparing VOCA and PECS and/or PE are necessary. Additionally, the development of evidence-based best practice with regard to a training protocol is imperative. Such a protocol would provide practitioners with empirically-based strategies, likely increasing the fidelity of the practice within the applied setting. Furthermore, this training protocol should not focus solely on the use of edible items as the targeted item for requesting, but also incorporate a generalization phase in the research design. Future research within the domain of aided AAC should continue to focus on such unanswered questions through replication with variation.

Finally, although the literature has been inconclusive as to which method of aided AAC is most effective for the acquisition of a mand repertoire, additional consideration of recent technological advances is on-going. The increased availability of hand-held computing devices, coupled with the decreasing cost of such devises; suggest an alternative to the costly VOCA such as the DynaVox. For example, the iPad is a hand-held computing device that costs $499 (http://www.apple.com/ipad/). The iPad, with the application Proloqu2go, which costs $187.99 (http://www.proloquo2go.com/buy/article/4-steps-to-proloquo2go), presents equivalent technological capabilities to that of the DynaVox.

When downloaded, the application Proloqu2go is pre-programmed with hundreds of items, activities, and carrier phrases, many of which are organized by category. The application allows an individual to develop personalized categories and “quick sets” to individualize the device based on need. The application is completely customizable, allowing an individual to change the volume, rate, pronunciation, and tone of the digitized output. Additionally, the user has the ability to upload any item or activity with a built-in camera and keyboard. Finally, the application tracks the items requested in 15-minute, hour, and full-day durations. This application is available on the iPad, iPod touch, and iPhone, allowing it to be transported in a variety of modalities ((http://www.proloquo2go.com/buy/article/4-steps-to-proloquo2go).

Although the use of the iPad has become increasingly popular within the field of autism intervention (http://www.cbsnews.com/8301-18560_162-20124225/apps-for-autism-communicating-on-the-ipad), a comparison of the iPad as a VOCA to PE has not been reported to date. The currently described dissertation evaluated the effectiveness of the iPad with the application Proloqu2go as a VOCA and provided a comparison to picture exchange.

CHAPTER 3
METHOD

Participants

As presented in Table 1, the participants were five children, all male, diagnosed with autism, with a mean age of 4.5-years. None of the participants had a history of formal mand training, using either picture exchange or voice-output communication aids at the onset of the study. Each of the participants had training using a picture-based schedule, which required them to remove a picture depicting an activity and place the picture in a designated folder, and therefore had history with the topography required for picture based communication. Additionally, they each presented the ability to communicate using pre-linguistic behaviors such as pointing, gesturing, and leading.

Joel

Joel was five-years and five-months old at the time of the study. He received 26.5 hours of classroom instruction, 30-minutes per week of group and individual speech therapy, 45-minutes per week of occupational therapy, and eight hours per month of behavior supervision. His *Verbal Behavior-Milestones Assessment and Placement Program*, barriers assessment, indicated a score of 4 for manding and 3 for echoics, which is equivalent to an absent mand and a weak echoic repertoire. Joel's teacher identified his disruptive behaviors as including crying and biting his fingers.

Axel

Axel was four-years and three-months old at the time of the study. He received 26.5 hours of classroom instruction, 30-minutes per week of group and individual speech therapy, 45-mintes per week of occupational therapy, and 8-hours per month of behavior supervision. Axel demonstrated a limited mand and echoic repertoire, with a score of 2 in both domains, as measured by the *Verbal Behavior-Milestones Assessment and Placement Program*, barriers assessment. Axel's teacher reported his behaviors of concern included whining and crying, aggression towards staff and peers, head banging, and flopping to the floor.

Aaron

Aaron was four-years and one-month old at the time of the study. He received 26.5 hours of classroom instruction, 30-minutes per week of group and individual speech therapy, 45-mintes per week of occupational therapy, and 8-hours per month of behavior supervision. Aaron demonstrated a weak mand and absent echoic repertoire, with scores of 3 and 4 respectively, as measured by the *Verbal Behavior-Milestones Assessment and Placement Program*, barriers assessment. Aaron's teacher reported his behaviors of concern included aggression (i.e., hitting) towards staff and whining.

Peter

Peter was three- years and 10 months old at the time of the study. He received 10 hours per week of classroom-based instruction, 30-minutes per week of group and individual speech therapy, 45-minutes per week of occupational therapy, and eight hours per month of behavior supervision. He presented an absent mand and echoic repertoire as measured by the *Verbal Behavior-Milestones Assessment and Placement Program*, barriers assessment, with a score of 4 in both domains. Peter's teacher reported his behaviors of concern included whining and crying.

Rick

Rick was five-years and 11 months old at the time of the study. He received 10 hours per week of classroom-based instruction, 30-minutes per week of group and individual speech therapy, 45-minutes per week of occupational therapy, and eight hours per month of behavior supervision. He demonstrated a weak mand and absent echoic repertoire as measured by the *Verbal Behavior-Milestones Assessment and Placement Program*, barriers assessment, with scores of 3 and 4, respectively. Rick's teacher reported his behaviors of concern included aggression (i.e., hitting) towards staff, whining and crying, and flopping to the floor.

Materials and Setting

During PE baseline and training the materials included 2X2-inch laminated pictures depicting one tangible item and a Velcro picture exchange book. The picture exchange book was plastic and contained a Velcro strip on the cover, where the picture was secured. These pictures were produced using the application Proloqu2Go and were identical to those pictures used for VOCA training. The VOCA baseline and training materials included the iPad version two and the application Proloquo2Go, which provided 2X2 inch pictures depicting an item on the screen of the iPad. Each session was conducted in the participant's classroom at a child-sized table, with child-sized chairs, where the instructor sat within two feet, to the left, the participant. Sessions were conducted in an unused area of the classroom, which had a partition segregating it from the remainder of the classroom. During training, the remainder of the classroom was engaged in center-based or free play activities (e.g., task completion, sensory table, etc.)10-20 feet away from where mand training was conducted. The reinforcers used for baseline and training were determined through a preference assessment (multiple stimulus without replacement) and varied by participant.

Table 1. Participant Information

Name	Diagnosis	Age	*VB-MAPP,* Barriers Mand Score	*VB-MAPP,* Barriers Echoic Score	Behaviors of Concern
Joel	Autism	5.5	4- Absent	4- Absent	Crying Biting his fingers
Axel	Autism	4.3	2- Limited	2-Limited	Crying Self-Injury Aggression Flopping to floor
Aaron	Autism	4.1	4- Absent	4-Absent	Aggression Whining
Peter	Autism	3.10	4- Absent	4-Absent	Whining Crying
Rick	Autism	5.11	4- Absent	3-Weak	Aggression Crying Whining Flopping to floor

Table 2. Materials

Device	Materials
VOCA	iPad version 2; Application Proloqu2Go
PE	Laminated 2 inch pictures; Velcro; PE book

Dependent Measures

During all phases of the study, frequency data were collected on independent manding. A probe data system was used to track the occurrence of vocalizations during baseline, training, and maintenance trials. Data were also collected on disruptive behavior using a 30-second partial interval recording method. Finally, trials to criterion were calculated post-hoc. For manding with PE the topography of independent responding was defined as the selection and exchange of the picture depicting the requested item with the listener/instructor. For manding with VOCA, the topography of independent responding was defined as the touching of the picture, on the screen of the iPad, depicting the requested item with enough force to evoke the digitized vocal output (e.g., “ball.”). Vocalizations included any audible utterance made by the participant; for example, “ba” or “uh” were counted as a vocalization. Disruptive behaviors included any behavior that interfered with the skill acquisition of the participant or their peers; for example aggression, self-injury, and self-stimulatory behavior were considered disruptive. These behaviors were initially identified by the classroom teacher and varied per participant.

Data Collectors, Instructors, and Procedural Fidelity

For interobserver agreement purposes, two investigators were present during the preference assessment, baseline phase, device preference assessment, and during 42% of training sessions. Each data collector/instructor was experienced in both mand training and ABA instruction. Two of the data collectors/instructors were masters-level students in Applied Behavior Analysis. The third was a doctoral student in Educational Psychology and a Board Certified Behavior Analyst. Additionally, each data collector/instructor had attended trainings on prompting strategies and data collection and had demonstrated these skills for the primary investigator prior to the commencement of the study. Finally, a procedural fidelity checklist was used to ensure that the procedures were completed as outlined. Procedural fidelity data were collected during all sessions, throughout the study.

Interobserver Agreement

Interobserver agreement (IOA) data were collected for 42% of all training and during 100% of baseline and 100% of the device preference assessments. IOA data were calculated by dividing the number of agreements by the number of agreements plus disagreements. IOA during baseline was 100% for both picture exchange and voice output manding, 80% (range, 35-100%) for vocalizations, and 89% (range, 25-100%) for disruptions. IOA during training was 100% for VOCA and PE independent mands, 86% (range, 62-100%) for vocalizations, and 95% (range, 75-100%) for disruptions. IOA for the device preference assessment was 100% for both PE and VOCA communication, 85% (range, 53-100%) for vocalizations, and 98% (range, 83-100%) for disruptive behaviors.

Experimental Design

A single subject, alternating treatment with initial baseline design was used for the study (Cooper et al., 2007). The training of PE and the iPad were presented in random order across the five participants (i.e., Axel began training with the VOCA, while Aaron with PE), with equal opportunity for each device. An initial baseline phase was included to demonstrate the inability or limited ability of the participants to communicate using the VOCA device or PE, prior to training. Following acquisition of the communication devices a preference assessment for the devices was conducted to determine participant preference for either PE or VOCA.

Baseline and Training Procedures

Stimulus Preference Assessment

A multiple-stimulus without replacement preference assessment (MSWO) (DeLeon & Iwata, 1996) was conducted for each participant. Prior to the assessment, an opened-ended preference survey was provided to each of the participants' teachers and used to determine, which items would be presented in the assessment. For three of the five participants the teacher indicated social activities (i.e, tickling, high-fives, etc.) as being preferred. Given the participants' inability to use picture based communication, these items were not included in the preference assessment, for a requirement for their inclusion would be a pictorial selection of the social activities. For example, if a participant were to select "tickles", they would have to select a picture depicting tickles. During the assessment the student was presented with an array of five items and told to "take one". Once the participant selected one item from the array, he or she was provided access to the selected item for one minute. The remaining four items were then placed in an array and the participant was again be instructed to “take one”, and provided access to the selected item for one minute. If the participant did not select an item from the array, during any point of the assessment, all items were removed and the five items were re-presented on the table in varying locations. This sequence continued until all items were presented in all possible locations. The three items that the child selected most often, when available, were used for baseline and communication training.

Baseline

Baseline data were collected for 10 minute sessions, which lasted until stable responding was determined for independent manding. During baseline, three items were placed within the child’s view. The item that the child reached for first was used for each respective baseline trial. The iPad and Velcro book with the corresponding picture on the screen or cover were both available for the child to request the item. The data collector/instructor did not interact with the child during the baseline phase unless the child independently manded for the item or demonstrated disruptive behavior. If the participant independently manded for the item, access to that item was granted for 30 seconds. If the participant did not request the item within 30-seconds, an item selected at random was presented to the participant for 30 seconds. This was done to maintain the participant’s interest and decrease the likelihood of disruptive behavior. The randomly selected item was then removed from the participant, and the trail was considered complete. This continued until the 10-minute session was completed.

Mand Training

Mand training was conducted in sessions, which consisted of 15 opportunities to respond. The sessions were conducted during the participant's free play/center time, so as to not interfere with their instructional time. One session, per device was conducted per educational day. However, for those participants who attended school all day (i.e., Joel, Axel, and Aaron), two sessions per day were conducted per device, per day, for the educational schedule was identical in both the morning and afternoon sessions (i.e., centers, circle, free play, circle, etc.). A trial consisted of the participant being presented with three preferred items as identified through the preference assessment; the item that the participant had first reached for used for each respective training trial. Immediately after the reaching response, either the PE device or the iPad was placed in front of the child, with the picture depicting the item on the PE book or iPad screen, in a field of one picture. The item remained in view of the child but beyond his reach. A constant time delay with full physical prompts (Sigafoos, Doss, & Reichle, 1989) was used to teach manding across both modalities. If the participant did not independently mand for the item within five seconds of its presentation, the instructor/listener provided a full physical prompt to either evoke the digitized message or the selection and exchange of the picture. No vocal prompting was used during training (e.g., "What do you want?", "Press this button.", "Hand me the picture.", etc.). Following both prompted and independent responding, the participant was granted access to the item for 30 seconds after which the item was removed and the trial was considered complete. Trials continued in this sequence either until the participant had 15 opportunities to respond or until the participant met a mastery criterion of 80% unprompted responses for each device, respectively, across two consecutive sessions. If a participant met mastery criteria for one device prior to the other, maintenance sessions were conducted until the participant met criterion for both devices. The duration of the sessions varied from five to ten minutes, depending on the rate of independent responding; however, there were always15 opportunities to respond, per session.

Device Preference Assessment

The device preference assessment was conducted in the same manner as baseline. The devices were presented in a random order of location (i.e., to the right and left side of the participant) to control for possible hand and location dominance. Three-to-four, 10-minute preference assessments were conducted.

Social Validity Survey

Following the acquisition of a communication repertoire and device preference assessment, each of the participant's behavior analyst, classroom teacher, and classroom assistants were asked to complete a survey (see Appendix D) to assess the social validity of (a) communication training, (b) the use of the iPad as an aided AAC, and (c) preference for the iPad and PE system. Since the setting where the study took place had access to both PE and the VOCA device, questions regarding incorporation of the respective devices into the classroom routine were also included.

CHAPTER 4
RESULTS

Joel

Stimulus Preference Assessment

The results from Joel's preference assessment are depicted in Figures 1 and 2. The five items included in his initial preference assessment were oreo cookie, cheese-it cracker, ball, frog, and candy (Swedish Fish). He selected the oreo cookie 31%, cheese-it 71%, ball 28%, frog toy 38%, and candy 16% of the time it was available. Following the third session of training due to parental concerns regarding the use of certain edible reinforcers, a second preference assessment was conducted for Joel. The items used for the second assessment were ball, frog toy, ladybug toy, elephant, and graham cracker. Joel selected the ball 25%, frog toy 41%, ladybug toy 55%, elephant 29%, and graham cracker 29% of the time it was available.

Independent Mands

Joel's baseline and training results for manding are depicted in Figure 3. Baseline data were collected for five sessions with Joel. He independently manded using picture exchange an average of 3% of the time, (range, 0-14%). Joel independently manded using the VOCA an average of 7% of the time, (range of 0-14%). Joel met criterion for picture exchange during the 15th session of training. He averaged 57% independent responding (range, 33-87%) during training sessions. Joel met criterion for VOCA in the 16th training session. He averaged 77% independent responding (range of 47-93%) during VOCA training sessions. Maintenance data were collected for session with two picture exchange sessions and averaged 90% independence (range, 80-100%). Maintenance data were collected for one VOCA session during which Joel responded at 100% independence. Although Joel met criterion during session 15 for picture exchange and session 17 for VOCA, his overall rate of independence was higher for VOCA (77%) than for picture exchange (57%). In terms of visual analysis, vertical distance and non-overlap between data paths indicates that the VOCA device produced higher rates of responding, despite Joel's acquisition in terms of creation for PE.

Vocalizations

Figure 4 depicts the average rate at which Joel emitted vocalizations during baseline and during communication training. Throughout baseline Joel emitted vocalizations during 61% of trials (range, 29-100%). He vocalized during an averaged of 73% of trials for picture exchange (range, 53-87%) and an average of 73% (range, 27-100%) of VOCA training trials. Which was a 13% increase from the average percentage of vocalizations during baseline, across both PE and the VOCA.

Disruptions

Figure 5 depicts the percentage of 30-second intervals during which Joel demonstrated disruptive behaviors. His disruptions occurred during 47% of 30-second intervals (range of 25-75%). These disruptions included biting his finger and whining. Joel's demonstration of disruptive behaviors decreased from an average of 47% of 30-second intervals during baseline to 12% (range 0-45%) of intervals during PE training and an average of 33% (range 0-75%) of intervals during VOCA training.

Device Preference Assessment

The results of Joel's device preference assessment are depicted in the right side of Figure 3. He demonstrated preference for the VOCA device during all four preference assessment sessions in that he used the VOCA during 52 of the 60 communication opportunities. He averaged 85% responding using the VOCA (range 80-90%). He averaged 11% responding using picture exchange (range, 6-13%). For only two trials throughout the four sessions, did Joel not respond using either device.

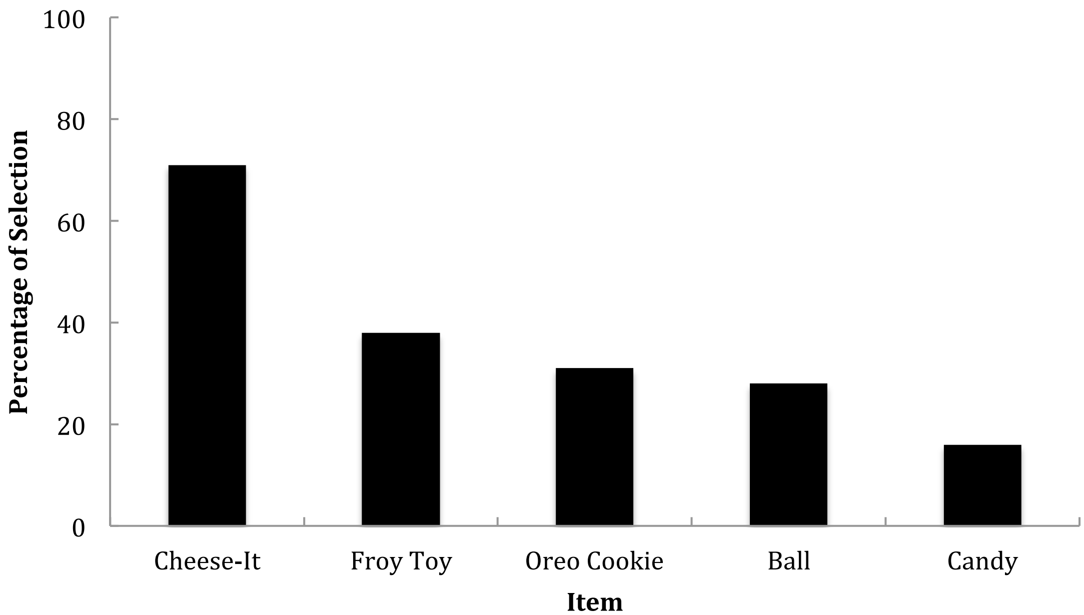

Figure 1. Joel's Stimulus Preference Assessment 1. This figure depicts the percentage of times Joel selected an item, when it was available.

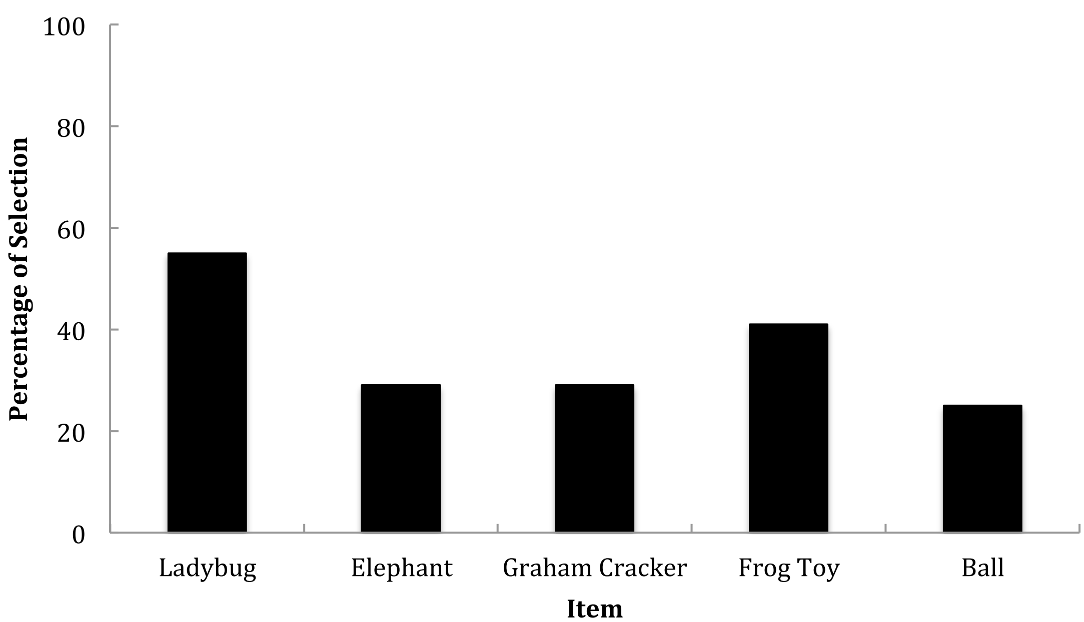

Figure 2. Joel's Stimulus Preference Assessment 2. This figure depicts the percentage of times Joel selected an item, when it was available.

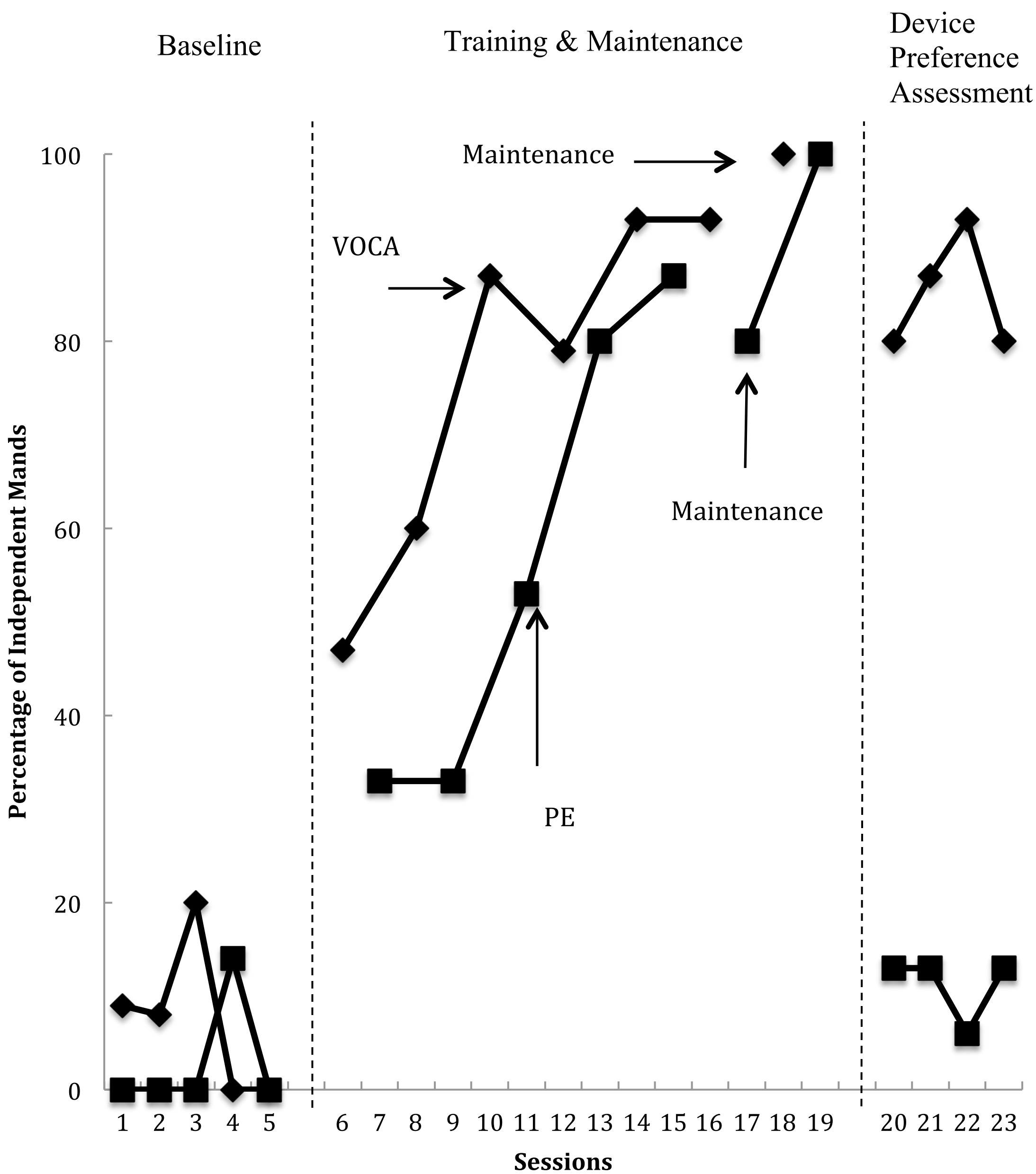

Figure 3. <u>Joel's Percentage of Independent Mands.</u> This figure depicts Joel's percentage of independent manding with picture exchange (PE) and voice output communication aid (VOCA) during baseline, training, maintenance, and the device preference assessment.

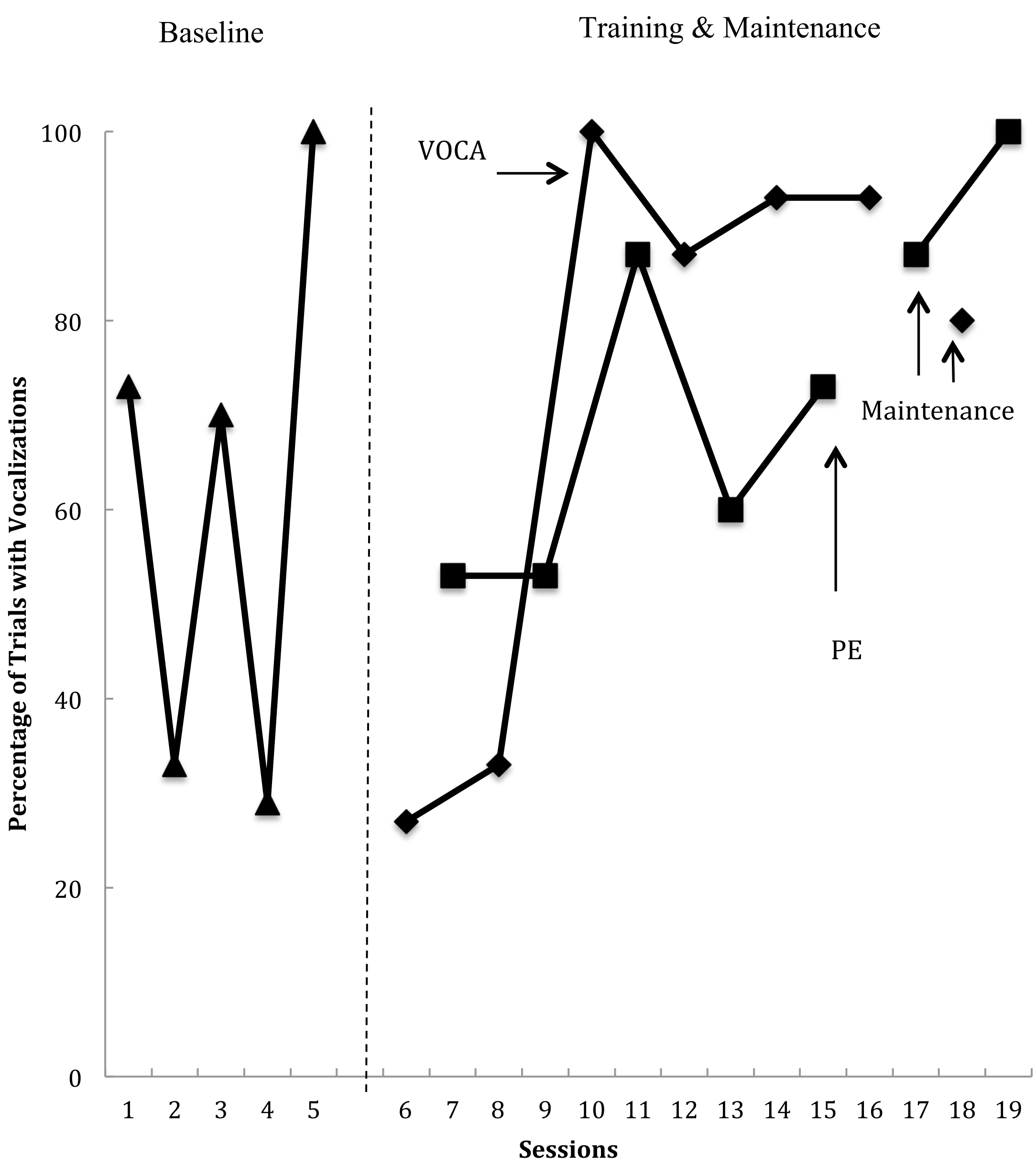

Figure 4. Joel's Vocalizations. This figure depicts the percentage of Joel's vocalizations during baseline, communication training, and maintenance across both picture exchange (PE) and the voice output communication
aid (VOCA).

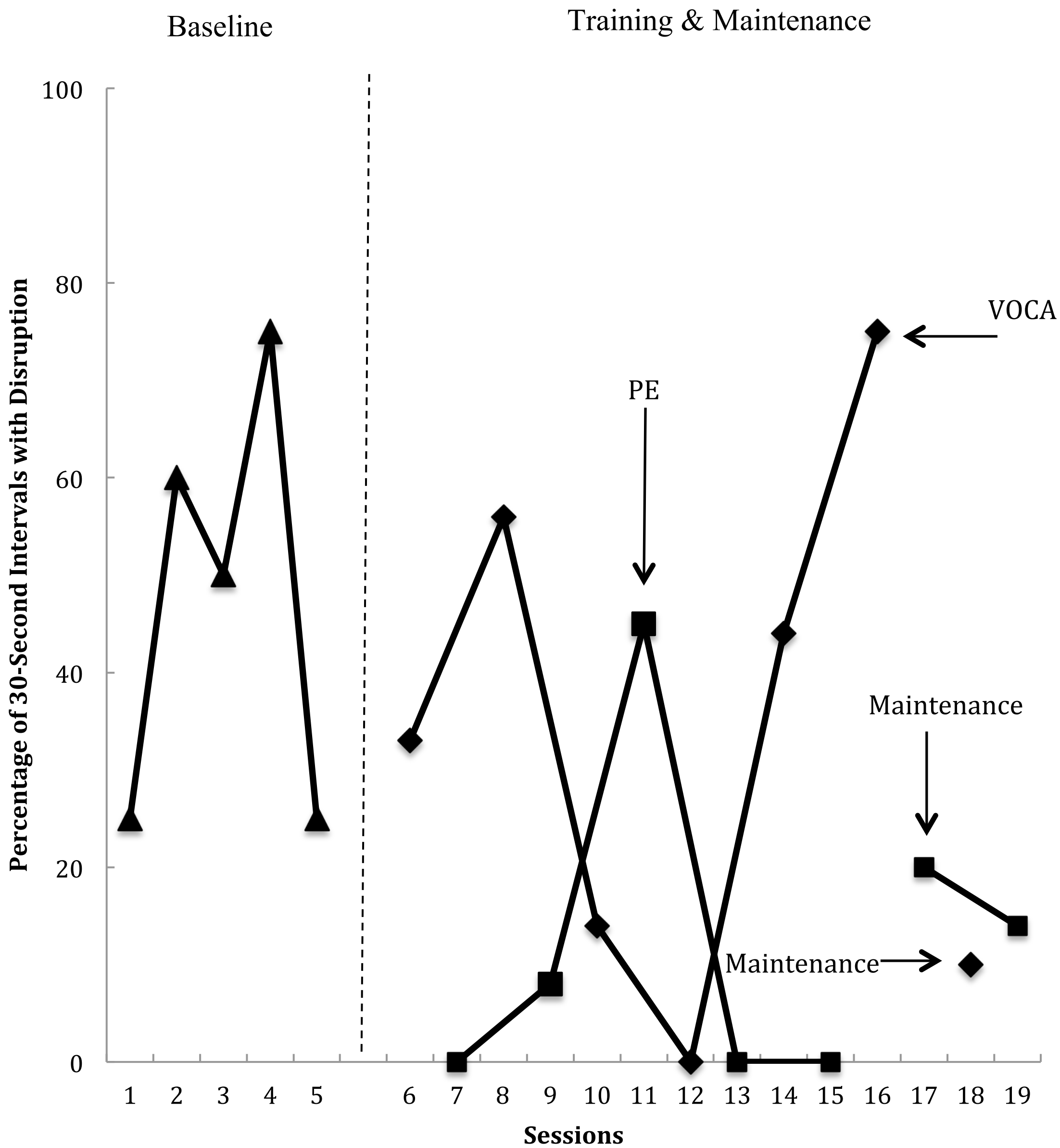

Figure 5. <u>Joel's Disruptive Behavior.</u> This figure depicts the percentage of 30-second intervals during which Joel demonstrated disruptive behaviors during baseline, training, and maintenance across both picture exchange (PE) and the voice output communication aid (VOCA).

Axel

Stimulus Preference Assessment

The results of Axel's stimulus preference assessment are depicted in Figure 6. The five items included in Axel's preference assessment included dog, book, ball, pretzels, and candy (Swedish Fish). He selected the dog 27%, the book 0%, the ball 38%, pretzels 41%, and candy 71% of the time when it was available.

Independent Mands

Baseline data were collected for three sessions with Axel, presented in Figure 7. Axel independently manded using picture exchange an average of 9% (range 8-10%) during baseline. He never independently manded using the VOCA device during baseline. Axel met criterion for VOCA training during session 3, with an average of 97% (range, 93-100%) independent responding during training sessions. He met criterion for PE during session 8, with an average of 83% (range, 60-100%) independent responding during training sessions. Maintenance data were collected for VOCA during sessions 5 through 9, where independent manding remained at 100% independence. Maintenance data were collected for picture exchange during session 10 and averaged 86% independence. In terms of visual analysis of the data, vertical distance and non-overlap of data paths, during training, indicates that the VOCA device produced higher rates of independent manding.

Vocalizations

Axel's average rate of vocalizations are depicted in Figure 8. He emitted vocalizations during 72% (range, 46-100%) of baseline trials. Axel emitted vocalizations during 32% (range, 0-93%) of picture exchange and 31% (range, 7-67%) of VOCA sessions.

This was a decrease from an average of 72% of trials with vocal utterances during baseline; however, this may be attributable to the use of edible reinforcers and the high rates of reinforcement for independent mands during training.

Disruptions

Axel's average frequency of disruptive behaviors per 30-second partial intervals are depicted in Figure 9. During baseline he demonstrated disruptive behavior during 20% (range, 5-45%) of 30-second intervals. These disruptions included whining, crying, and self-injurious behavior in the form of head banging. Axel demonstrated disruptive behavior during 7% (range, 0-18%) of 30-second intervals during picture exchange training and 9% (range, 0-40%) of 30-second intervals during VOCA training. This was a substantial decrease from baseline for both conditions.

Device Preference Assessment

The results of Axel's device preference assessment are depicted in Figure 6. He demonstrated preference for the VOCA device during all four preference assessment sessions. He averaged 98% (range, 93-100%) responding using VOCA. He averaged 2% (range, 0-6%) responding using picture exchange. Axel independently manded during all 60 opportunities to respond throughout the device preference assessment, using the VOCA device for 59 of those opportunities.

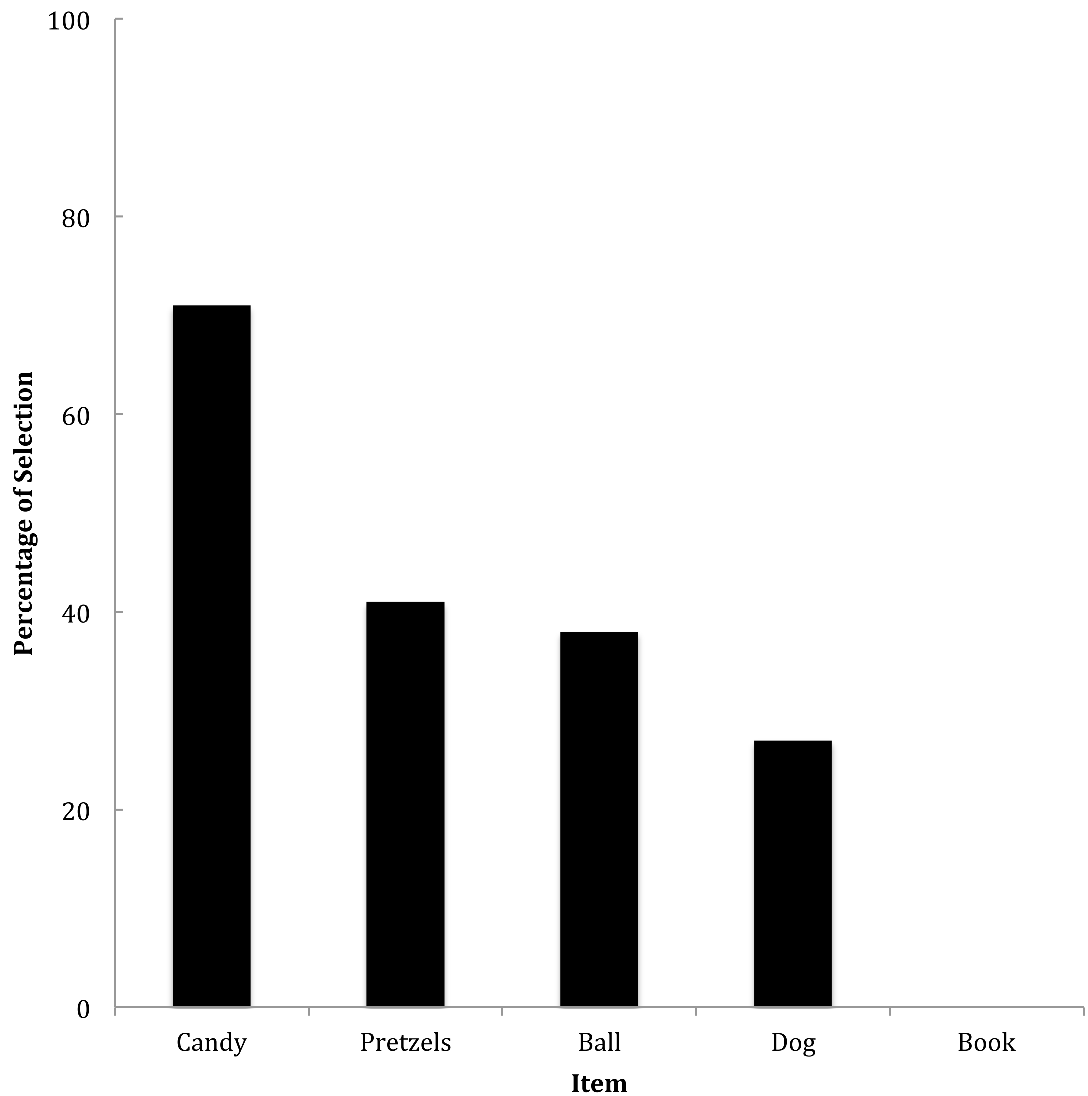

Figure 6. Axel's Stimulus Preference Assessment. This figure depicts the percentage of times Axel selected an item, when it was available.

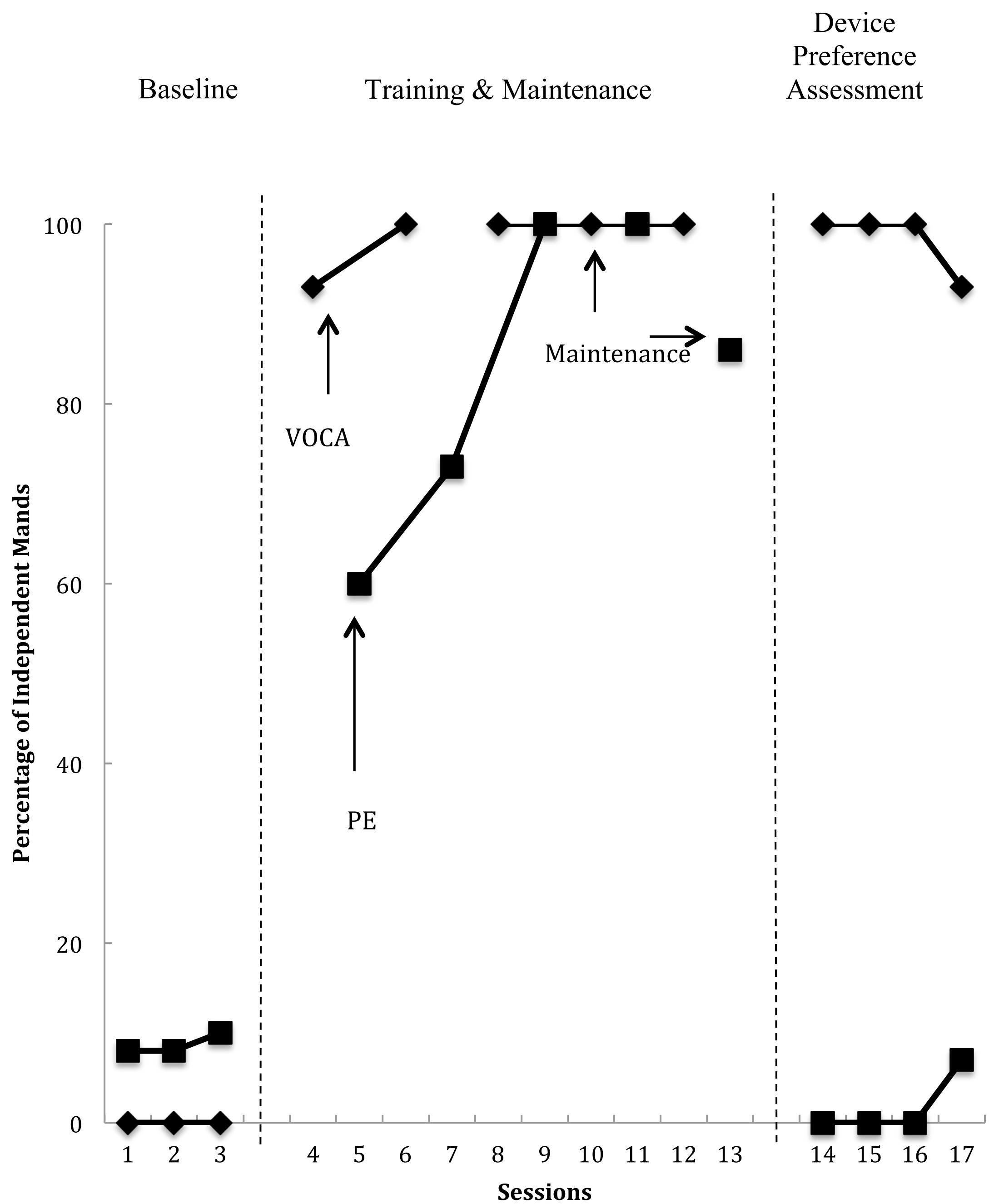

Figure 7. <u>Axel's Percentage of Independent Mands.</u> This figure depicts Axel's percentage of independent manding during picture exchange (PE) and voice output communication aid (VOCA) baseline, training, maintenance, and the device preference assessment.

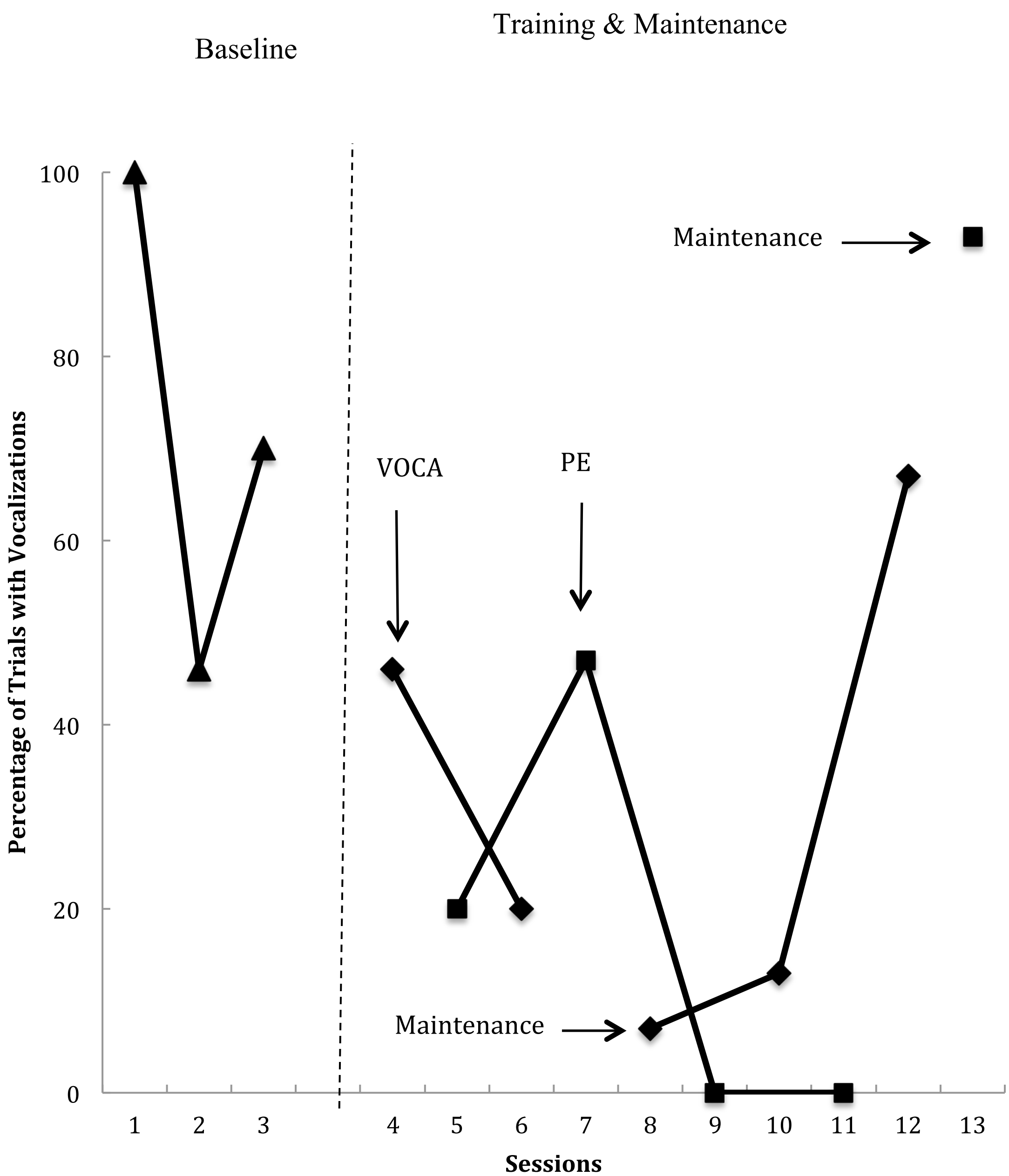

Figure 8. <u>Axel's Vocalizations.</u> This figure depicts the percentage of Axels' vocalizations during baseline, communication training, and maintenance across both picture exchange (PE) and the voice output communication aid (VOCA).

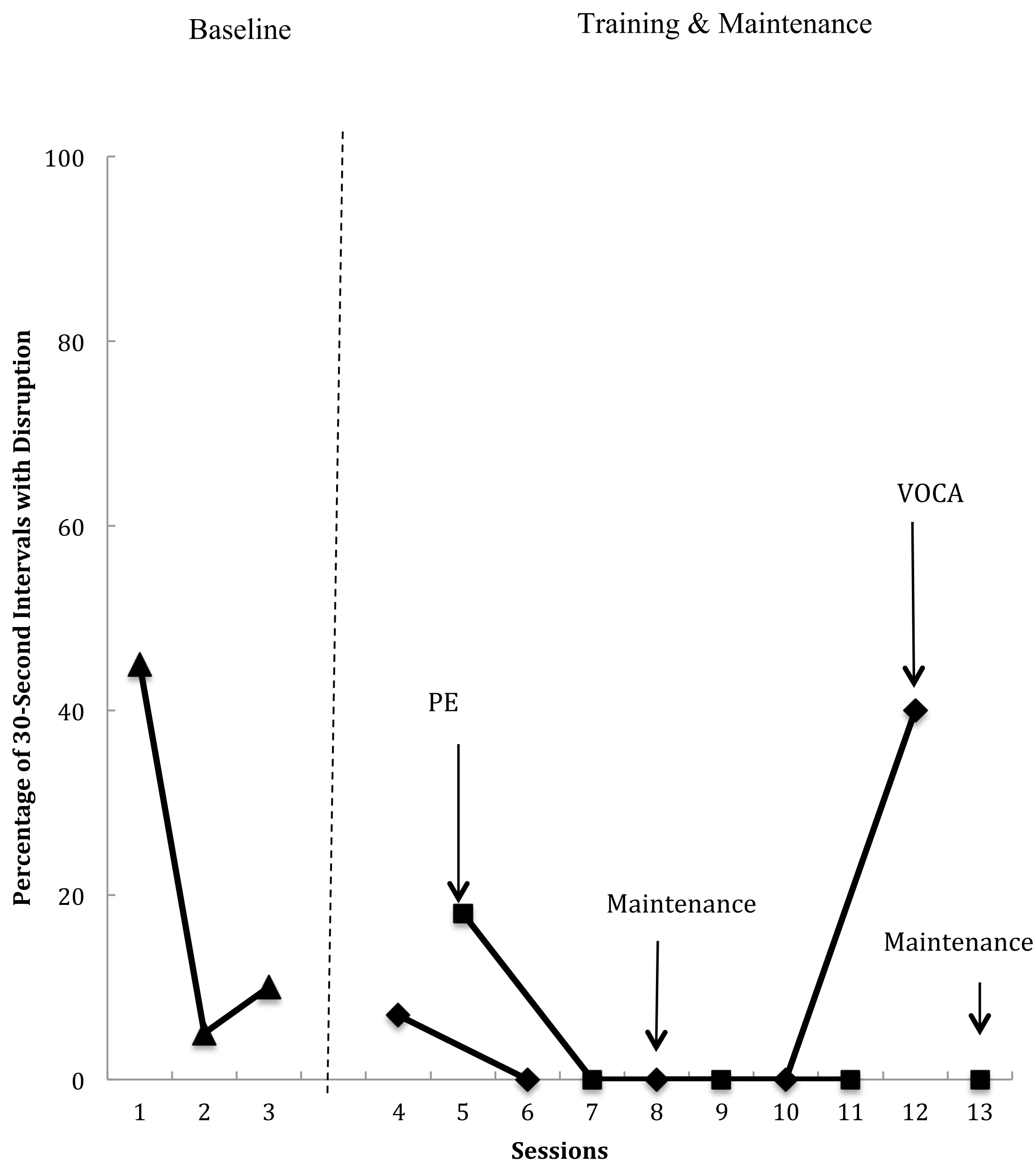

Figure 9. Axel's Disruptive Behavior. This figure depicts the percentage of 30-second intervals in which Axel demonstrated disruptive behaviors during baseline, training, and maintenance across both picture exchange (PE) and the voice output communication aid (VOCA).

Aaron

Stimulus Preference Assessment

The results of Aaron's stimulus preference assessment are depicted in Figure 10. The five items included in Aaron's preference assessment were candy, raisin, ball, koosh ball, and book. He selected candy 71%, raisin 45%, ball 29%, koosh ball 26%, and book 23% of the time it was available.

Independent Mands

Baseline data were collected for three sessions with Aaron, presented in Figure 11. Aaron did not independently mand with either device during baseline. Aaron met criterion for VOCA training during session 7, with an average of 84% (range, 80-87%) independence during training sessions. He met criterion for PE during session 16, with an average of 55% (range, of 26-92%) independence. Maintenance data were collected for VOCA during sessions 9 through 17 where independent manding averaged 86% (range, 73-100%) independence. Maintenance data were collected for picture exchange during session 18 and averaged 93% independence. In terms of visual analysis of the data, vertical distance and the non-overlap between data paths, during training, indicates the VOCA device produced higher rates of independent manding.

Vocalizations

Aaron's average rate of vocalizations are depicted in Figure 12. He emitted vocalizations during 84% (range, 80-90%) of baseline sessions. Aaron emitted vocalizations during 88% (range, 73-100%) of picture exchange sessions, an increase from baseline. He emitted vocalizations during 73% (range, 60-95%) of VOCA sessions, which was not an increase from baseline.

Disruptions

Aaron's average demonstration of disruptive behaviors per 30-second partial intervals is depicted in Figure 13. During baseline he demonstrated disruptive behavior during 8% (range, 0-15%) of 30-second intervals. These disruptions included whining, crying, and hitting. Aaron demonstrated disruptive behavior during 10% (range, 0-20%) of 30-second intervals during picture exchange sessions and 16% (range, 0-45%) of 30-second intervals during VOCA sessions, an increase from baseline.

Device Preference Assessment

The results of Aaron's device preference assessment are depicted on the right side of Figure 10. He demonstrated preference for the VOCA device during all four preference assessment sessions. He averaged 94% (range, 87-100%) responding using VOCA. He averaged 7% (range, 0-13%) responding using picture exchange. Aaron independently manded during all opportunities to respond throughout the device preference assessment, using the VOCA device to mand for 56 of the 60 opportunities to respond.

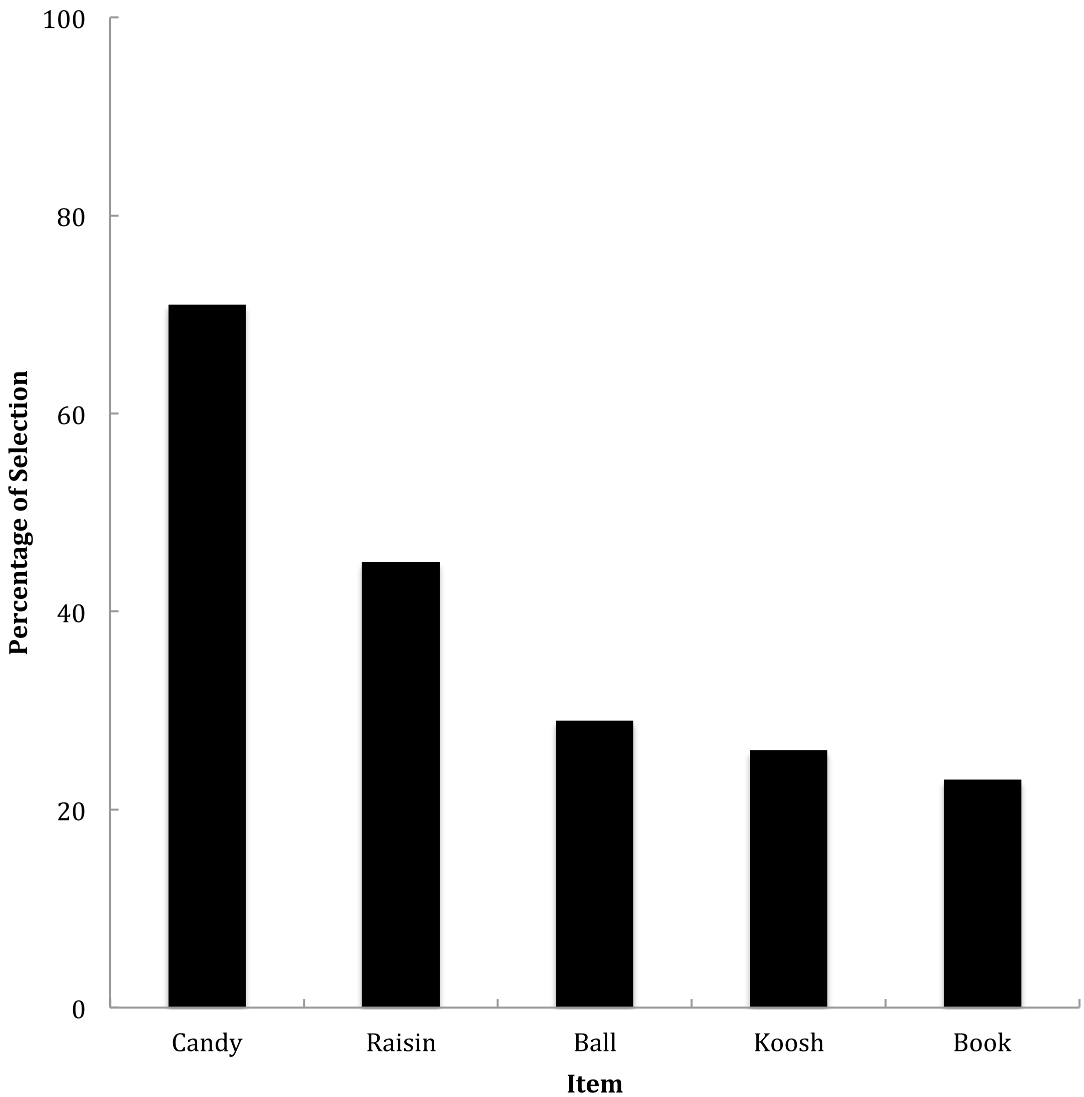

Figure 10. Aaron's Stimulus Preference Assessment. This figure depicts the percentage of times Aaron selected an item, when it was available.

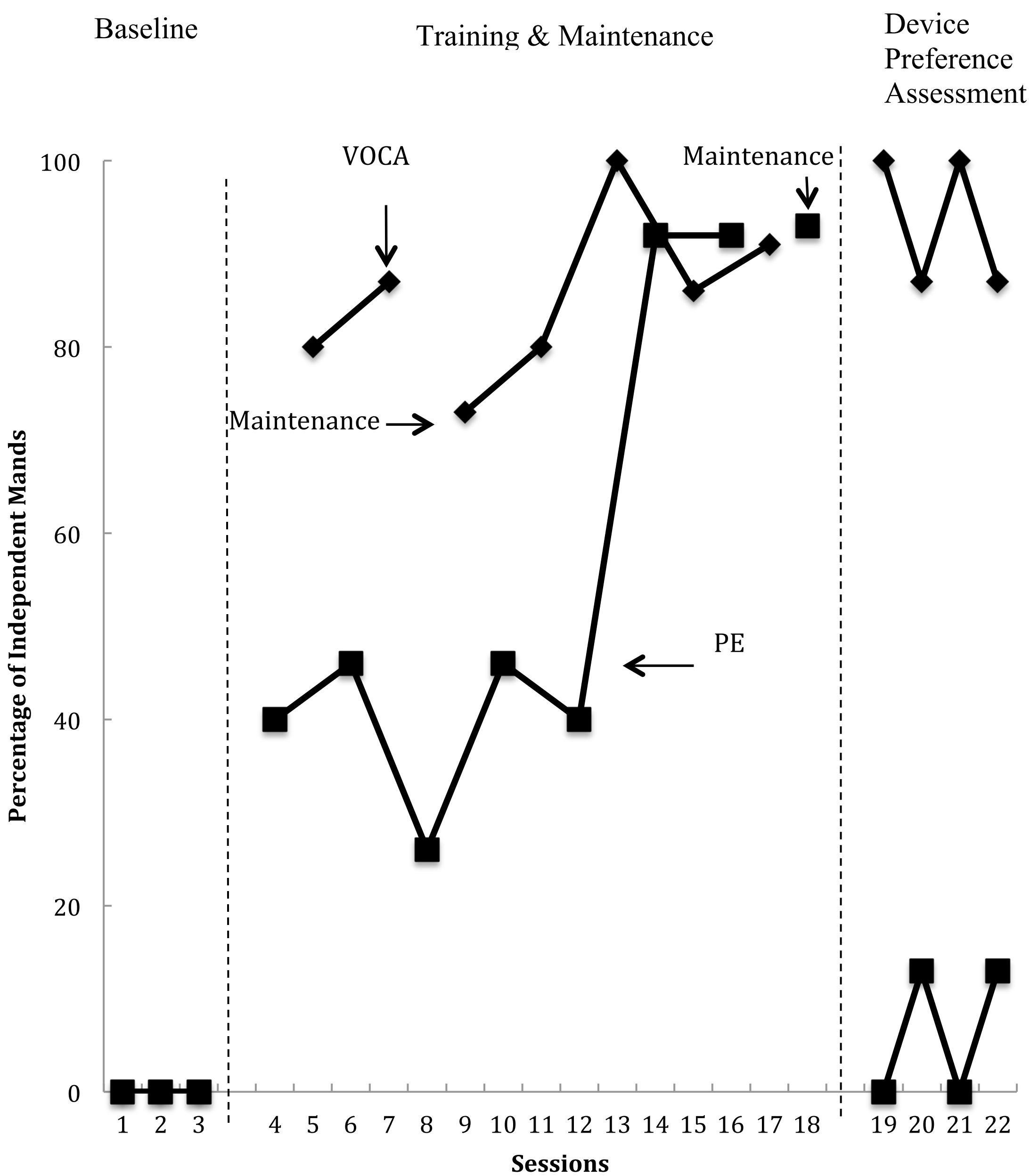

Figure 11. Aaron's Percentage of Independent Mands. This figure depicts Aaron's percentage of independent manding with picture exchange (PE) and the voice output communication aid (VOCA) baseline, training, maintenance, and the device preference assessment.

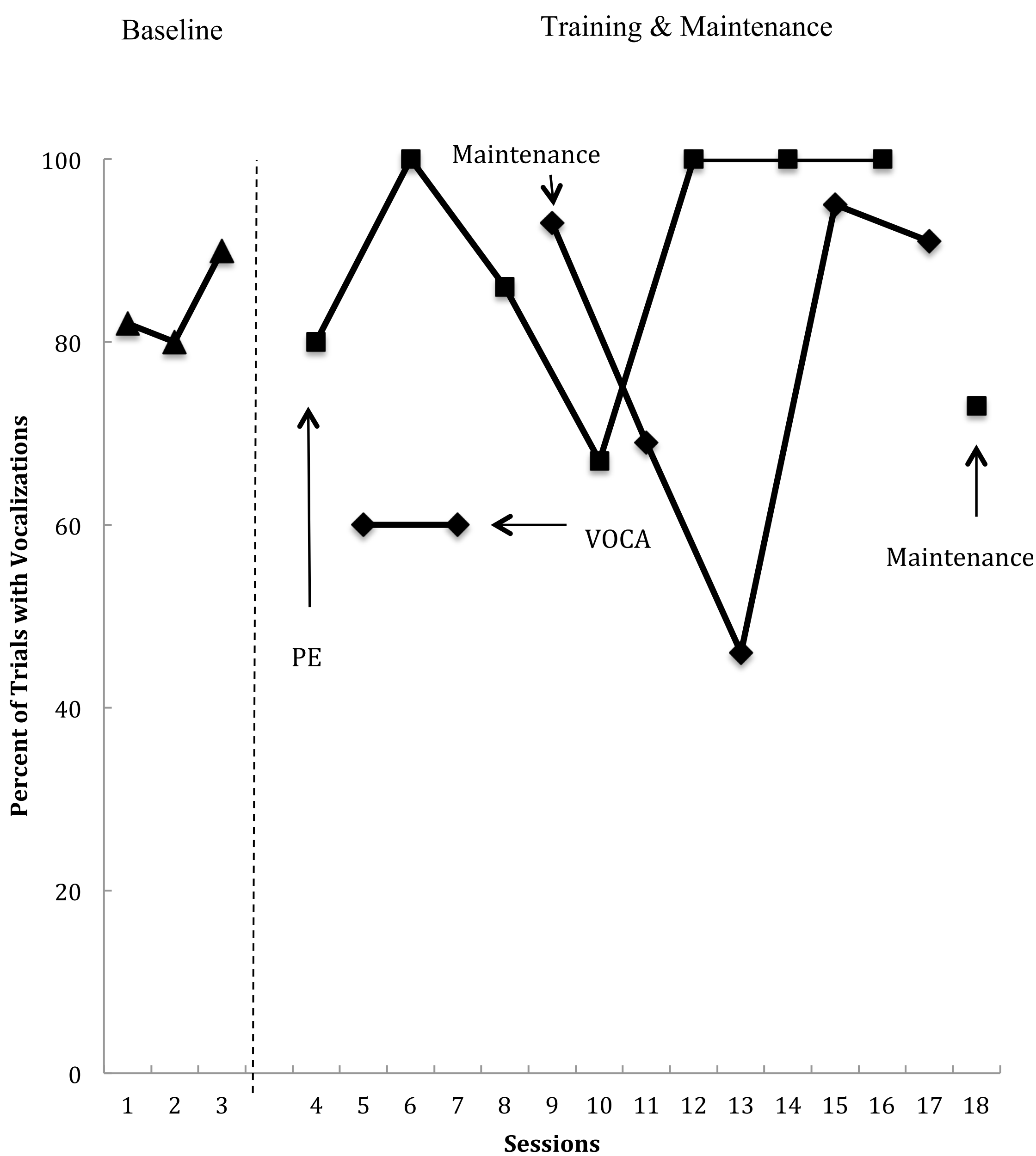

Figure 12. <u>Aaron's Vocalizations.</u> This figure depicts the percentage of Aaron's vocalizations during baseline, communication training, and maintenance across both picture exchange (PE) and the voice output communication aid (VOCA) training.

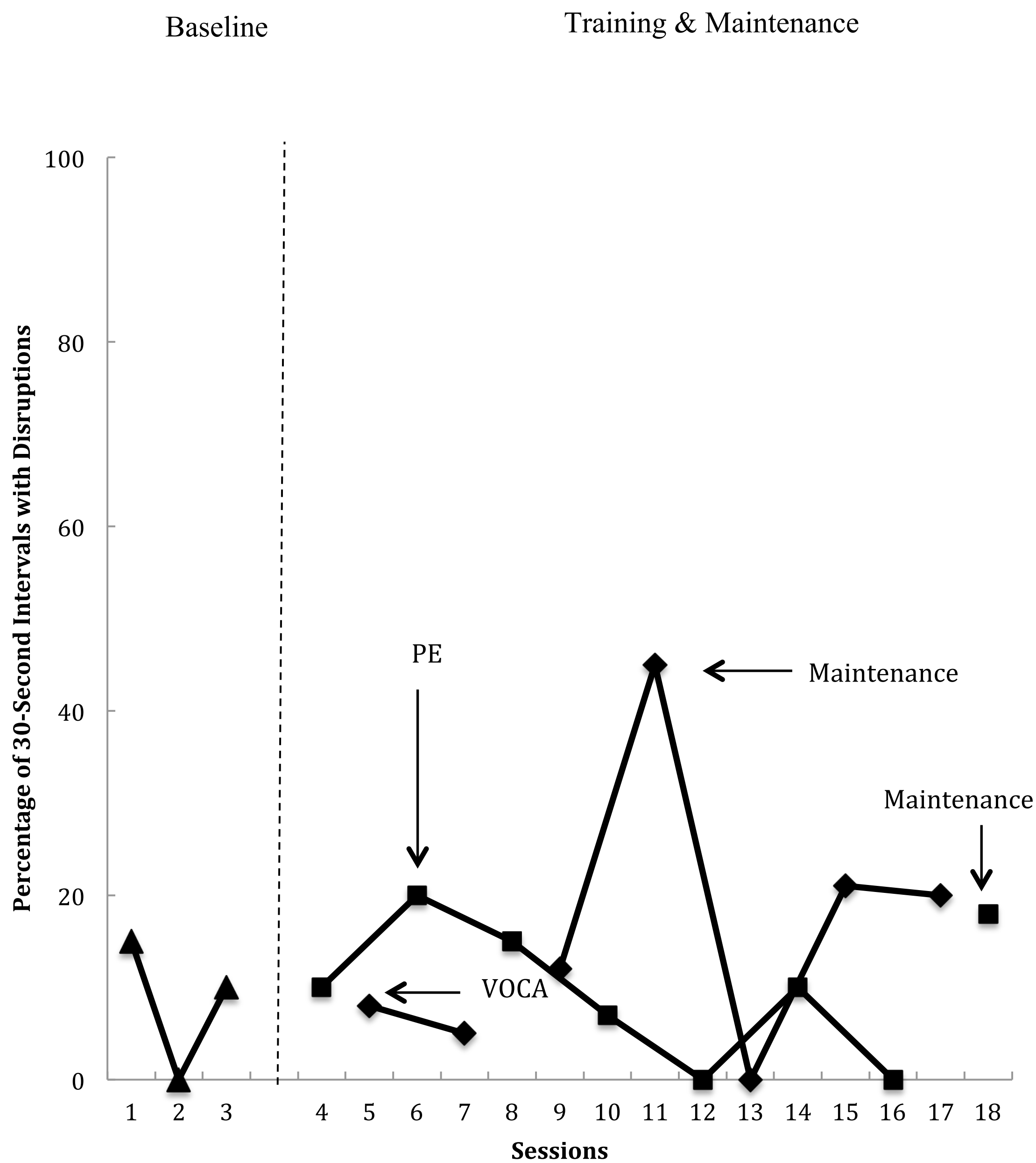

Figure 13. Aaron's Disruptive Behavior. This figure depicts the percentage of 30-second intervals during which Aaron demonstrated disruptive behaviors during baseline, training, and maintenance across both picture exchange (PE) and the voice output communication aid (VOCA).

Peter

Stimulus Preference Assessment

The results of Peter's stimulus preference assessment are depicted in Figure 14. The five items included in Peter's preference assessment were koosh ball, cheese-it cracker, ball, candy (Swedish Fish), and oreo cookie. He selected koosh ball 83%, cheese-it cracker 41%, and the ball 33% of the time it was available. He never selected candy or oreo cookie.

Independent Mands

Baseline data were collected for three sessions with Peter, presented in Figure 15. Peter did not independently mand with either device during baseline. He met criterion for VOCA training during session 13, with an average of 66% (range, of 13-100%) during training sessions, and he met criterion for PE during session 20, with an average of 50% (range of 0-87%) independence. Maintenance data were collected for VOCA during sessions 15 through 22 where independent manding averaged 98% (range, 93-100%) independence. Maintenance data were collected for picture exchange during session 23 and averaged 64% independence. In terms of visual analysis of the data, vertical distance and non-overlap of the data paths indicates that the VOCA device produced higher rates of independent manding.

Vocalizations

Peter's average rates of vocalizations are depicted in Figure 15. He emitted vocalizations during 62% of baseline trials (range, of 50-80%). He emitted vocalizations during 67% of picture exchange trials, a 5% increase from baseline. He only emitted vocalizations during 35% of VOCA training trials, a 25% decrease from baseline.

Disruptions.

Peter's average demonstration of disruptive behaviors per 30-second partial intervals is depicted in Figure 17. During baseline he demonstrated disruptive behavior during 2% of 30-second intervals (range, of 0-5%). These disruptions included whining and crying. Peter demonstrated disruptive behavior during none of the 30-second intervals during picture exchange training and 2% (range, 0-20%) of 30-second intervals during VOCA training, these data are consistent with baseline levels.

Device Preference Assessment

The results of Peter's device preference assessment are depicted in Figure 15. Three device preference assessments were conducted for Peter due to time constraints. He demonstrated preference for the VOCA device during all three preference assessment sessions. He averaged 78% responding using VOCA (range, 67-87%). He averaged 4% (range, 0-13%) responding using picture exchange. Peter did not respond with either device during 20% of trials (range, 27-33%). Peter responded using the VOCA device for 25 of the 32 opportunities to respond.

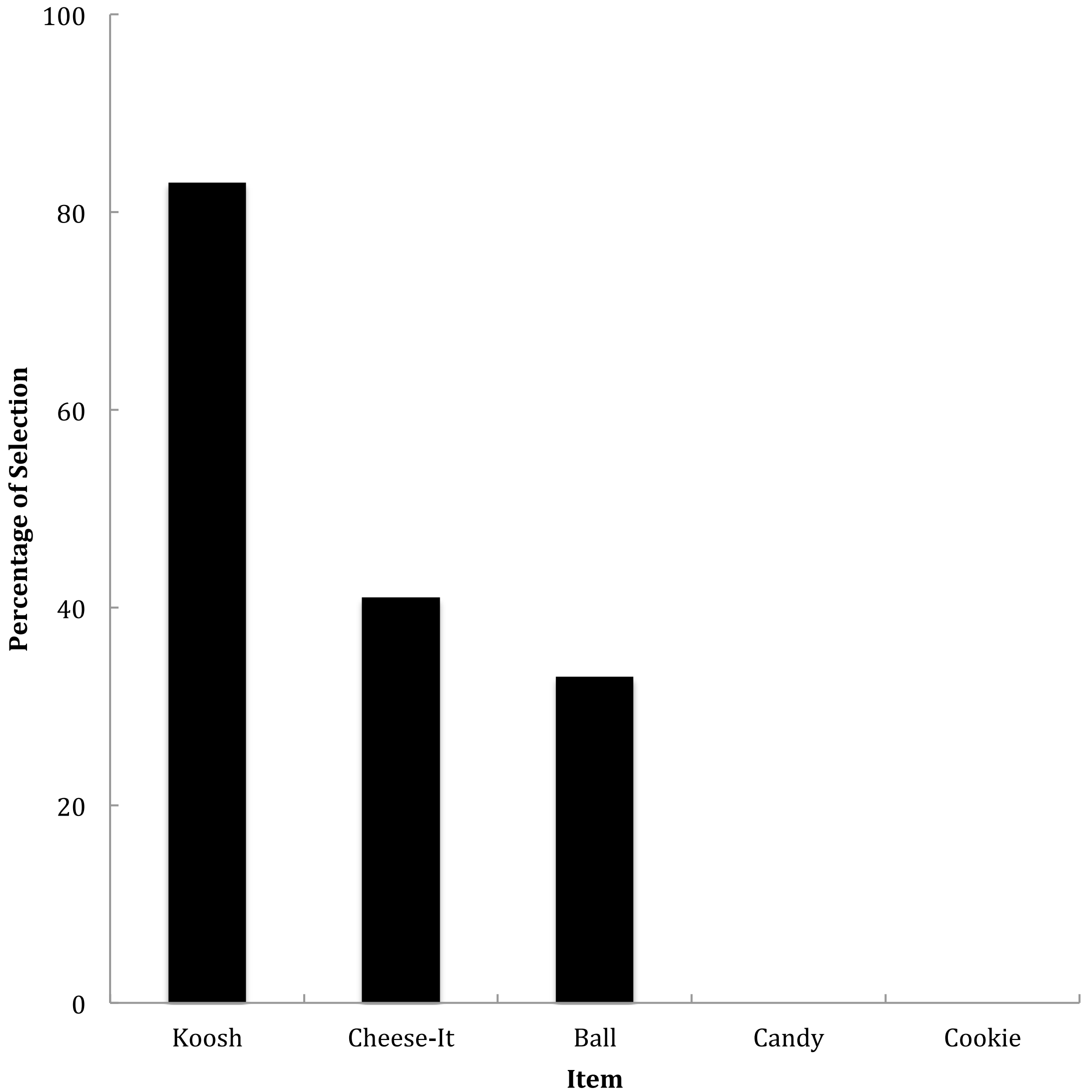

Figure 14. Peter's Stimulus Preference Assessment. This figure depicts the percentage of times Peter selected an item, when it was available.

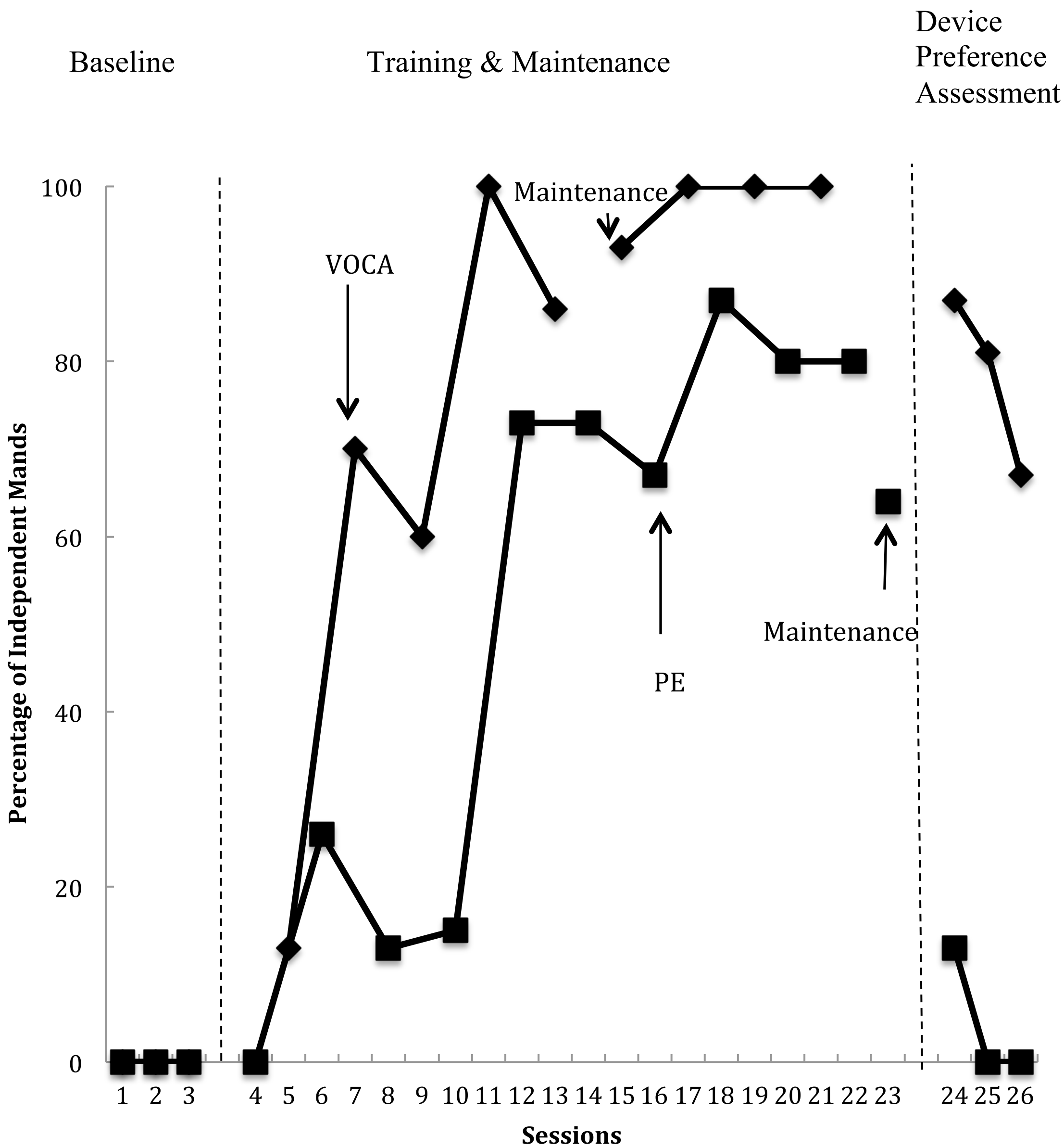

Figure 15. <u>Peter's Percentage of Independent Mands.</u> This figure depicts Peter's percentage of independent manding with picture exchange (PE) and the voice output communication aid (VOCA) during baseline, training, maintenance, and the device preference assessment.

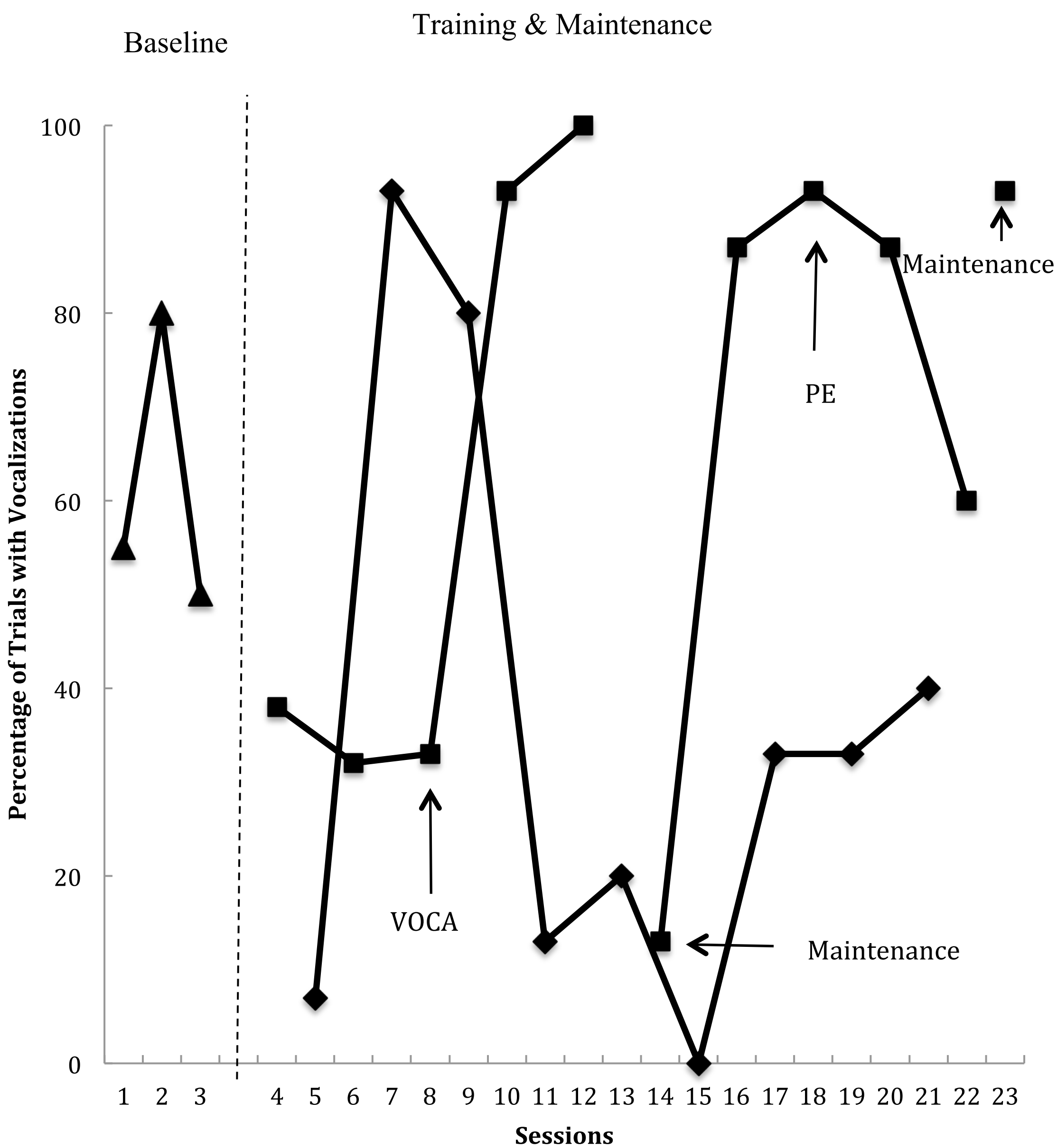

Figure 16. Peter's Vocalizations. This figure depicts the percentage of Peter's vocalizations during baseline, communication training, and maintenance across both picture exchange (PE) and voice output communication aid (VOCA) training.

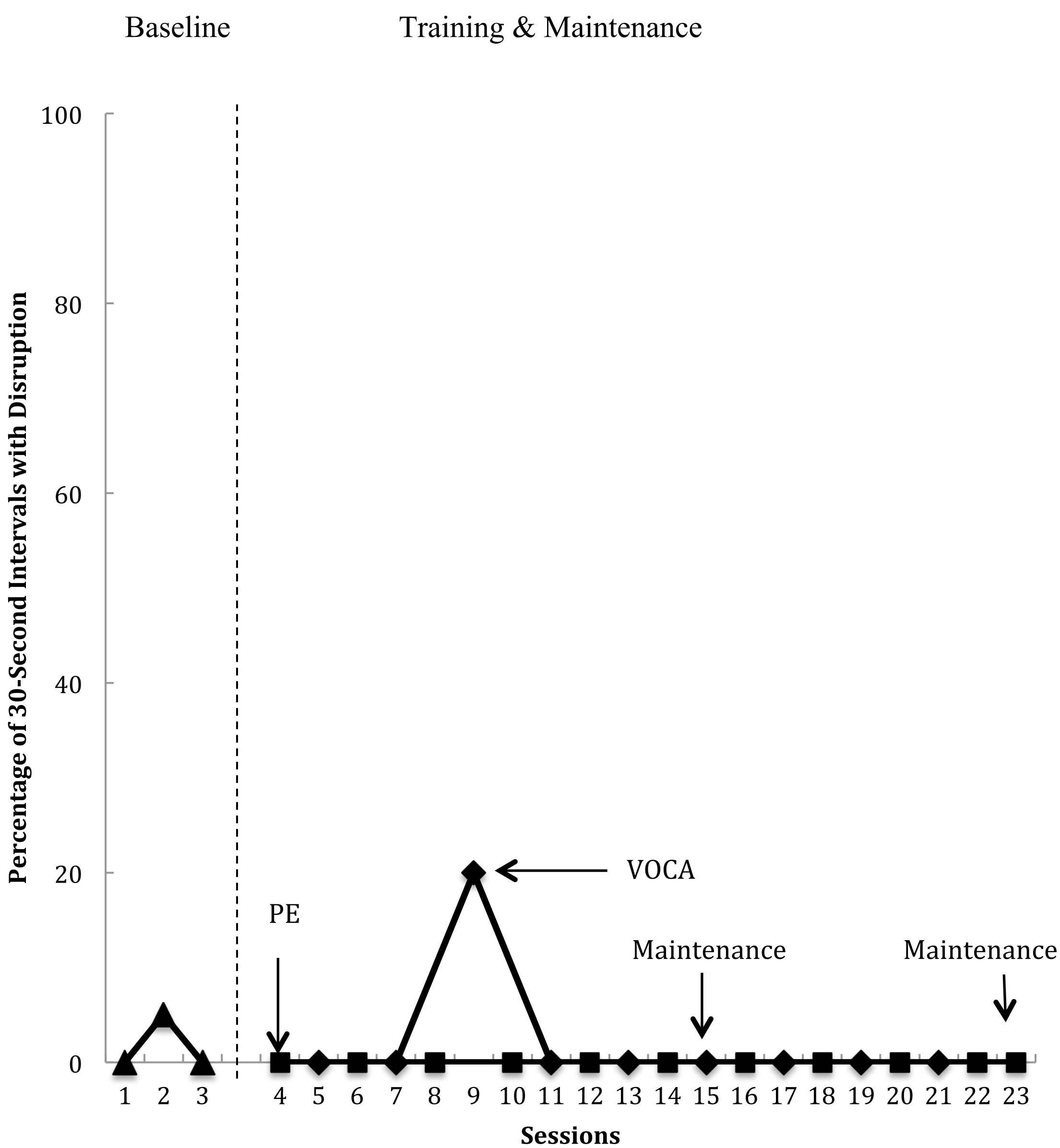

Figure 17. Peter's Disruptive Behavior. This figure depicts the percentage of 30-second intervals during which Peter demonstrated disruptive behaviors during baseline, training, and maintenance across both picture exchange (PE) and the voice output communication aid (VOCA).

Rick

Stimulus Preference Assessment

The results of Rick's stimulus preference assessment are depicted in Figure 18. The five items included in Rick's preference assessment were cheese-curl, frog toy, ball, candy (Swedish Fish), and oreo cookie. He selected cheese-curl 55%, candy 55%, frog toy 31%, ball 23%, and cookie 4% of the time it was available. He never selected candy or cookie.

Independent Mands

Baseline data were collected for three sessions with Rick, presented in Figure 19. Rick did not independently mand with either device during baseline. Then he met criterion for PE training during session 12, with an average of 76% (range, 60-86%) independence during training sessions. He met criterion for VOCA during session 23, with an average of 58% (range, 20-80%) independence. Maintenance data were collected for PE during sessions 14 through 22 where independent manding averaged 95% (range, 87-100%) independence. Maintenance data were not collected for VOCA due to time constraints. In terms of visual analysis, vertical distance between data paths and the non-overlap of data, indicates that PE produced higher rates of independent manding.

Vocalizations

Rick's average rates of vocalizations are depicted in Figure 20. He emitted vocalizations during 47% of baseline trials (range, 27-73%). Rick emitted vocalizations during 47% of picture exchange trials (range, 13-86%), consistent with baseline, and he emitted vocalizations during 52% of VOCA trials (range, 7-100%), a 5% increase from baseline.

Disruptions.

Rick's average frequency of disruptive behaviors per 30-second partial intervals is depicted in Figure 21. During baseline disruptive behavior occurred during 17% of 30-second intervals (range, 0-35%). These disruptions included whining and aggression (i.e., hitting) toward staff. Rick emitted disruptive behavior during 8% (range, 0-53%) of 30-second intervals during picture exchange training and 12% (range 0-53%) of 30-second intervals during VOCA training, a decrease from baseline.

Device Preference Assessment

The results of Rick's device preference assessment are depicted in Figure 19. Rick independently manded during all opportunities to respond throughout the device preference assessment, using PE to mand for 53 of the 60 opportunities to mand. He demonstrated preference for the PE device during all four preference assessment sessions. He averaged 89% (range, 80-100%) responding using PE. He averaged only 15% (range, 13-20%) responding using VOCA.

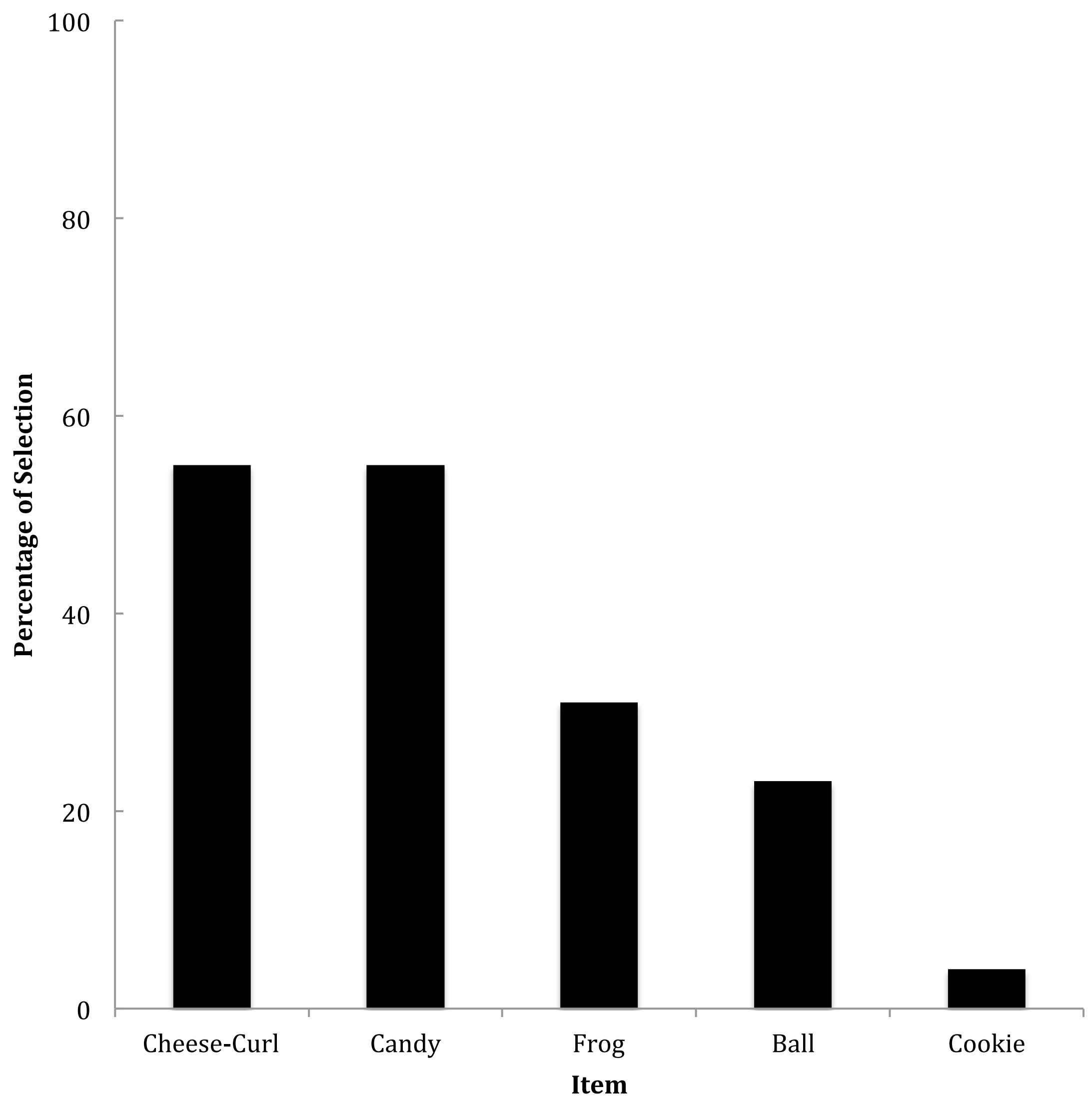

Figure 18. Rick's Stimulus Preference Assessment. This figure depicts the percentage of times Rick selected an item, when it was available.

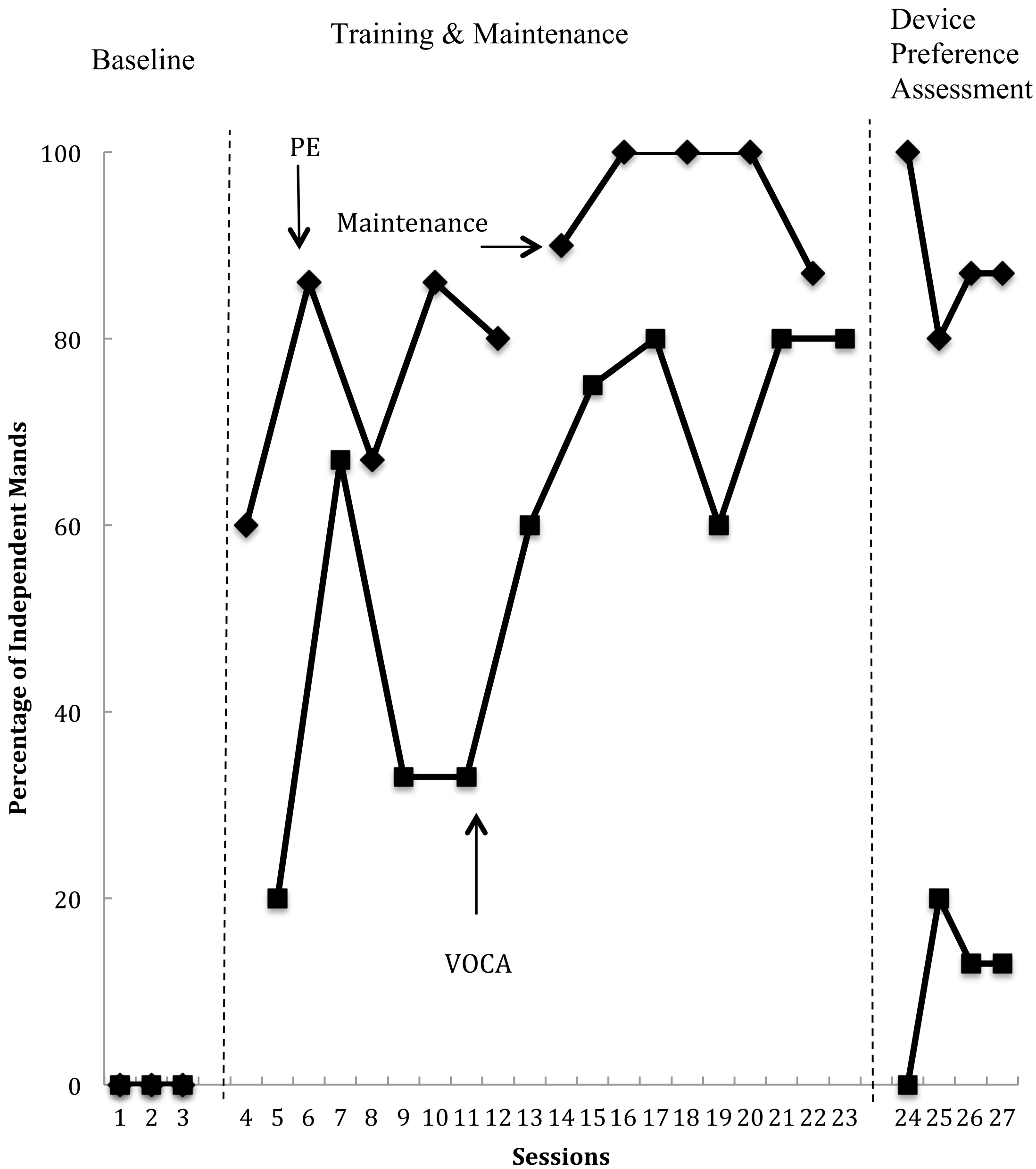

Figure 19. Rick's Percentage of Independent Mands. This figure depicts Rick's percentage of independent manding during picture exchange (PE) and the voice output communication aid (VOCA) during baseline, training, maintenance, and the device preference assessment.

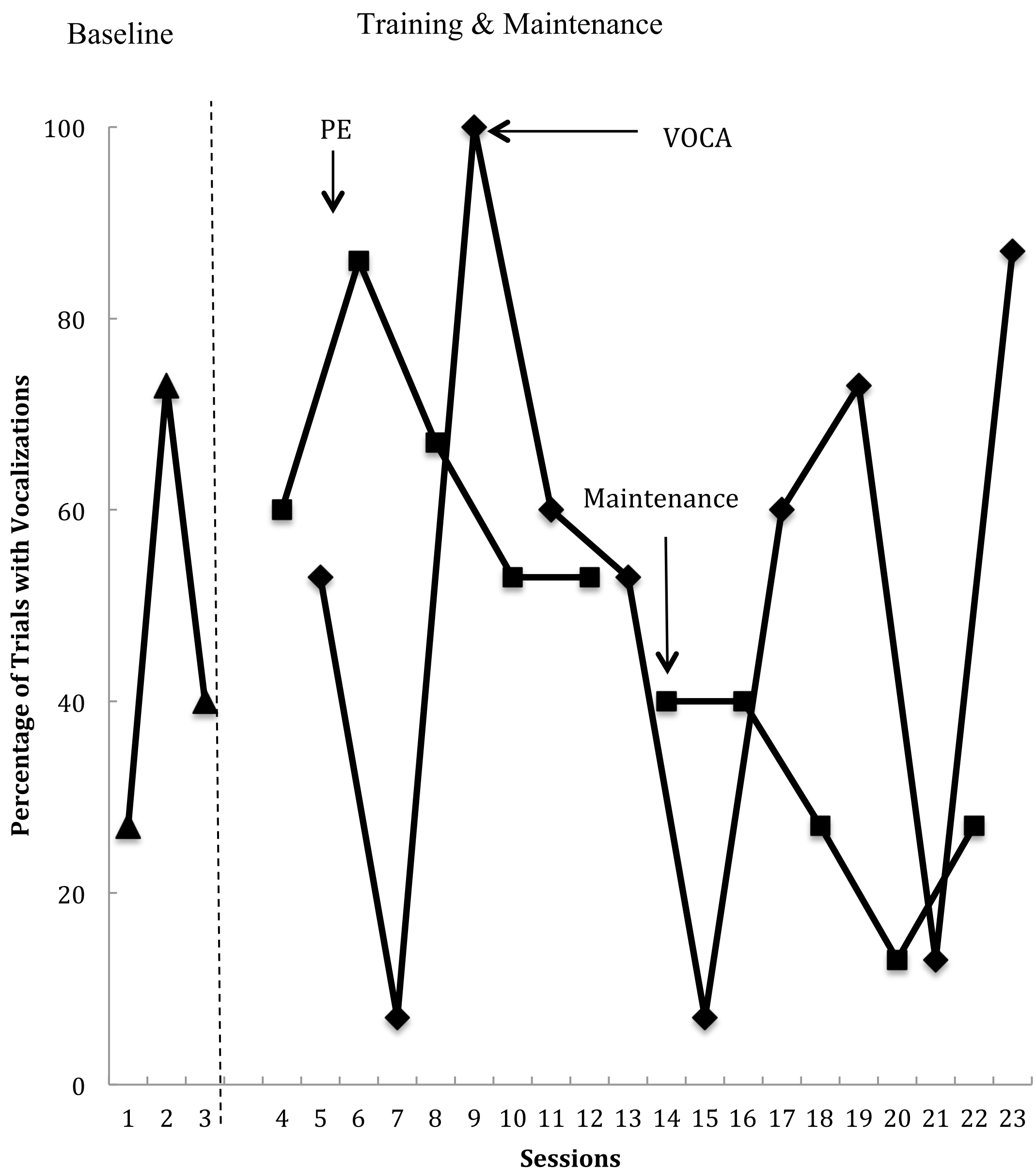

Figure 20. Rick's Vocalizations. This figure depicts the percentage of Rick's vocalizations during baseline, communication training, and maintenance across both picture exchange (PE) and voice output communication aid (VOCA) training.

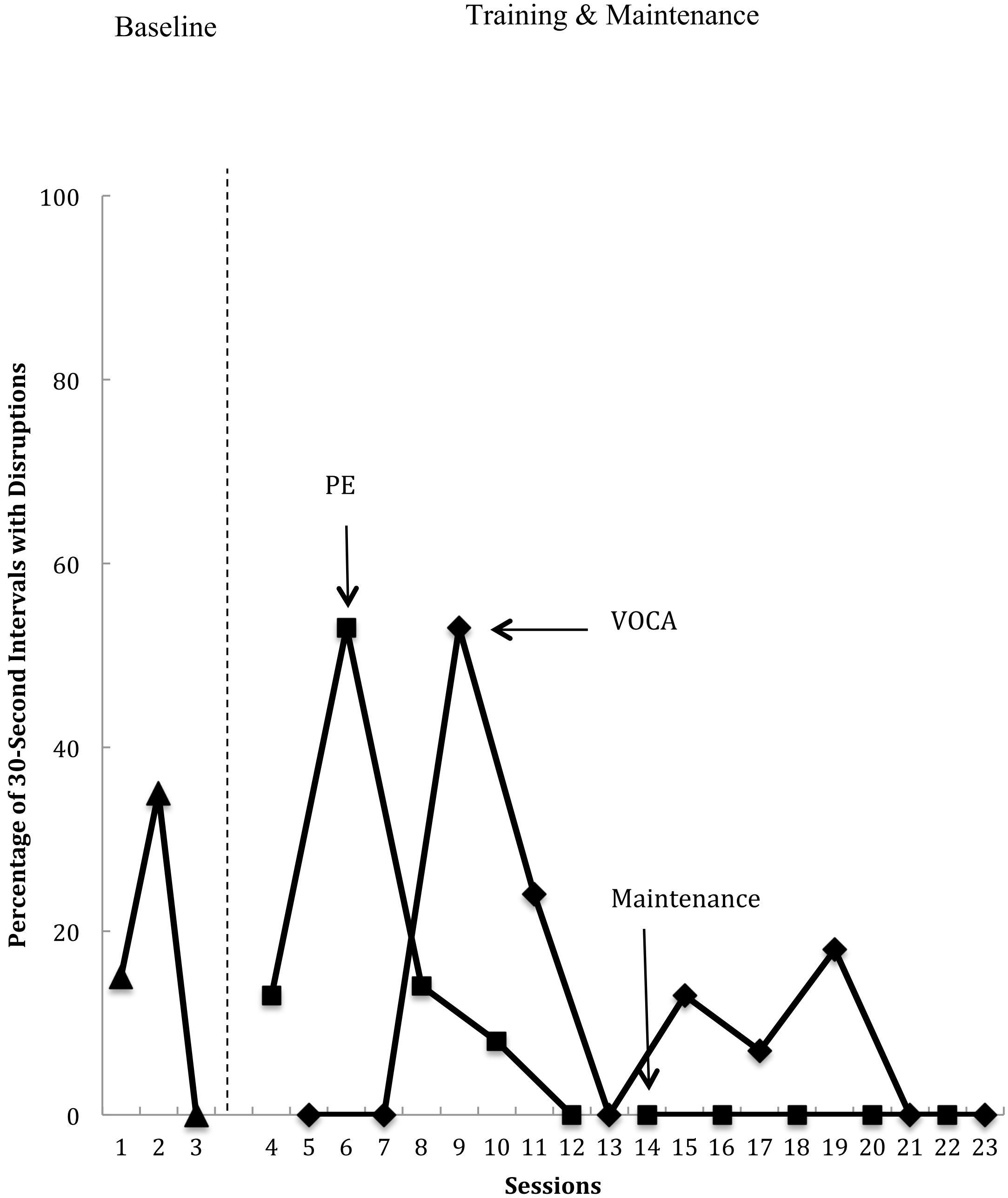

Figure 21. Rick's Disruptive Behavior. This figure depicts the percentage of 30-second intervals during which Rick demonstrated disruptive behaviors during baseline, training, and maintenance across both picture exchange (PE) and the voice output communication aid (VOCA).

Social Validity Survey

The results of the social validity survey are presented in Table 3. One classroom teacher, three paraprofessionals, and the classroom behavior analyst completed the survey. The survey included 7 questions, which were answered on a 7-point Likert scale. Given that both PE and the VOCA device, which was the iPad with the application Proloqu2G0, were available in the setting where this research was conducted, questions regarding the incorporation of the respective devices, into the classroom routine, were also included in the social validity survey.

As a group, the classroom staff reported that the training procedures for both devices were somewhat clear. They found that the use of the VOCA device was very acceptable, while use of PE was acceptable. They reported being very likely to incorporate mand training using the VOCA device into their classroom routine, while they were somewhat likely to incorporate use of PE into their classroom routine. They reported that they would be very likely to recommend use of the VOCA device, while they were likely to recommend use of PE in the future. Finally, they found the training procedures for both devices to be effective.

Table 3. Social Validity Survey Results

Item	Average Response	Range of Responses
1. How clear was your understanding of the training procedure?	5 Somewhat Clear	4-7
2. How effective did you find the training procedure?	6 Effective	6-7
3. How acceptable did you find the use of the iPad as a communication tool?	6 Very Acceptable	4-7
4. How acceptable did you find the use of Picture Exchange as a communication tool?	5 Acceptable	1-7
5. How likely are you to incorporate communication training using the iPad into your classroom routine?	6 Very Likely	1-7
6. How likely are you to incorporate communication training using Picture Exchange into your classroom routine?	5 Somewhat Likely	1-5
7. How likely is it that you would recommend communication training using the iPad in the future?	7 Very Likely	6-7
8. How likely is it that you would recommend communication training using Picture Exchange in the future?	5 Likely	4-7

CHAPTER 5
DISCUSSION

This discussion of the results is organized in the following manner. First, is a consideration of the results as they pertain to the dissertation's specific research questions. Second, there is a discussion of the limitations of the research design. Finally, implications for extended research are offered.

Research Questions

Question 1

What are the effects of a teaching procedure using full-physical prompting using the iPad with the application Proloqu2Go on the acquisition of a mand repertoire by students with autism?

The teaching procedure, which used a constant time delay with full physical prompting, was effective for teaching communication using the iPad with the application Proloqu2Go as a VOCA as is evident through visual analysis of the training data (see Figures 3, 7, 11, 15, and 19). The average number of training sessions required to meet the mastery criterion was five across all participants with a range of two-to-ten training sessions. Not only did all participants acquire the ability to mand using the iPad as a VOCA device, this skill also maintained across all four participants for whom maintenance data were collected. The average percentage of independent manding during maintenance was 97%, (range, 66-100%) independence.

Joel

Baseline data were collected for five sessions with Joel (see Figure 3). He averaged 7% independent responding with the VOCA device during baseline. Joel required six training sessions to meet mastery criterion using the VOCA device. His percentage of independent responding was 77% throughout the training sessions. One maintenance session was conducted with Joel where he responded at 100% independence. Joel's overall average percentage of independence across both training and maintenance was 80%.

Axel

Baseline data were collected for three sessions with Axel (see Figure 7). Axel did not independently mand using the iPad during baseline. He met mastery criterion after only two training sessions and averaged 97% independent responding. Maintenance data were collected for three sessions with Axel. He manded at 100% independence during maintenance. Axel's overall percentage of independence across both training and maintenance was 99%.

Aaron

Baseline data were collected for three sessions with Aaron (see Figure 11). He did not independently mand using the VOCA device during baseline. Aaron required only two training sessions to meet mastery criterion with the VOCA device. During these training sessions he averaged 84% independence. Maintenance data were collected for five sessions with Aaron. He averaged 86% independence during maintenance. Aaron's overall percentage of independence was 85% independence across both training and maintenance.

Peter

Baseline data were collected for three sessions with Peter (see Figure 15). He never independently manded using the VOCA device during baseline. He required five training sessions to meet mastery criterion and averaged 65% independence during training. Maintenance data were collected for four sessions with Peter. He independently manded an average of 98% during maintenance. Peter's overall percentage of independence was 80% across both training and maintenance.

Rick

Baseline data were collected for three sessions with Rick (see Figure 19). He never independently manded during baseline. Rick required 10 training sessions to meet mastery criterion with the iPad, averaging 59% independence. Maintenance data were not collected on Rick's use of the iPad due to time constraints.

Rationale for the Training Procedure

The literature with regard to VOCA training procedures has not provided a clear, best practice. As described in Chapter 2, a variety of training procedures have been employed for VOCA training including most-to-least prompting and shaping techniques (Durand 1999; Sigafoos, 2009), gestural and verbal prompting (Schepis et al., 1998), and the use of physical prompting only (Sigafoos et al., 2004; Sigafoos, 2009). The results of the current study were consistent with those of Sigafoos and colleagues (2004) and Sigafoos (2009) in that the use of only physical prompts was an effective teaching strategy for the acquisition of a mand repertoire using VOCA. Therefore, the current study adds to the literature base suggesting that the use of a constant time delay procedure, with full physical prompts is effective in the acquisition of a mand repertoire using VOCA.

Question 2

What are the effects of a teaching procedure using full-physical prompting using Picture Exchange (PE) on the acquisition of a mand repertoire by students with autism?

Despite the slower acquisition of a mand repertoire in four of the five participants when compared to the VOCA device, the training procedure for picture exchange, which used a constant time delay procedure, with full-physical prompts was effective in the acquisition of a mand repertoire in all five participants (see Figures 3, 7, 11, 15, and 19). The average number of training sessions necessary to reach a criterion of 80% independence across two consecutive sessions was six, with a range of four-to-nine training sessions. Thus, not only was the mand repertoire acquired, it was acquired at a relatively fast rate.

Additionally, this skill was maintained for four of the five participants. During maintenance the average rate of independence was 93%, (range, 80-100%) independence. One participant did not demonstrate maintenance of PE acquisition as he demonstrated only 64% independence during his maintenance probe.

Joel

Baseline data were collected for five sessions with Joel, where he averaged 5% independence (see Figure 3). Joel required five training sessions to meet mastery criterion with PE. He averaged 57% independence during training. Maintenance data were collected for two sessions. Joel averaged 90% independence during maintenance. His overall independence during maintenance and training was 67% independence.

Axel

Baseline data were collected for three sessions with Axel, where he averaged 12% independence (see Figure 7). He required four training sessions to reach mastery criterion and averaged 83% independence during training. Maintenance data were collected for one session, where Axel responded at 86% independence. His overall percentage of independence during training and maintenance was 84%.

Aaron

Baseline data were collected for three sessions with Aaron (see Figure 11). He never independently manded during baseline. Aaron required seven training sessions to reach mastery criterion. He averaged 55% independence during training. Maintenance data were collected for one session, where Aaron averaged 93% independent responding. His overall percentage of independence during both training and maintenance was 59%.

Peter

Baseline data were collected for three sessions with Peter (see Figure 15). He never independently manded using PE during baseline. He required 10 training sessions to reach mastery criterion and averaged 52% independence during training. Maintenance data were collected for one session with Peter. Peter did not maintain his ability to mand independently using PE, as his average percentage of independence was at 64%. His overall percentage of independence across training and maintenance was 53%.

Rick

Baseline data were collected for three sessions with Rick (see Figure 19). Rick did not independently mand during baseline. He required five training sessions to reach mastery criterion and averaged 76% independence during training. Maintenance data were collected for five sessions, where Rick averaged 95% independence. His overall percentage of independent manding across both training and maintenance was 86%.

Rationale for the Training Procedure

Despite literature that supports its effectiveness (e.g., Yoder & Liberman, 2010; Gordon et. al., 2011; Ganz & Simpson, 2004, etc.), the decision to use constant time delay procedure with full-physical prompting, rather than the PECS protocol was made for two reasons. First, according to its creators (Frost & Bondy, 2002), Phase I of the PECS protocol requires a two-to-one ratio, instructor-to-student. That is, for each student two instructors must be present, one assuming the role of the listener and one assuming the role of the instructor. Given the practical limitations of this requirement, the PECS protocol could not be used for training purposes as it was not possible to ensure the presence of two instructors at each training session.

Second, the PECS protocol could not be appropriately adapted for use with a voice output communication device. Beck and colleagues (2008) attempted to adapt the PECS protocol for use with a VOCA; however, one major limitation to their investigation was the unequal response effort required during Phase II of their training. As research question three of this dissertation seeks to provide comparison data on the acquisition across devices, the decision to use equivalent training procedures was made to control for any differences in responding that may have been the result of the training procedure. That is, any differences in acquisition should be the result of the augmentative device used, not the training procedure employed.

Question 3

Which device, the iPad with the application Proloqu2Go or PE, produces more independent manding for students with autism?

As is consistent with the literature, the results with respect to this research question were somewhat mixed. Bock et. al., (2005) compared acquisition rates across PECS and a VOCA in six, four-year-old boys diagnosed with a developmental disability. Results of their investigation indicated that three participants acquired PECS at a faster rate, while three acquired VOCA at a faster rate. Sigafoos et al. (2009) also compared acquisition rates in PE and VOCA, of a 15-year-old boy diagnosed with Downs Syndrome. Results of this investigation yielded identical rates of acquisition across both devices. Finally, Son et al. (2006) compared the effectiveness of VOCA and PECS with three participants. The results of this investigation indicated fewer trials necessary to reach a mastery criterion of 75% independence for VOCA; however, all participants acquired the ability to mand using either device.

With respect to the current study, the VOCA device required fewer trials to criterion with an average of five trials, while picture exchange averaged six training sessions to reach the same criterion. For three of the five participants, fewer trials to criterion were required for mand training using the iPad; however, for two of the three participants fewer training sessions were required with PE to reach a mastery criterion of 80% independent responding across two consecutive sessions.

Despite these differences in acquisition, for four of the five participants, use of the VOCA produced higher rates of independent manding with an average of 85% independent responding during training and maintenance for VOCA and 64% independence for PE. Two participants acquired PE with fewer trials to criterion than VOCA. These differences in acquisition rates may be attributable to the heterogeneous nature of autism and varying learning characteristics prior to intervention.

Joel

Joel required five training sessions to meet mastery criterion for PE and six training sessions to meet mastery criterion for VOCA; however, throughout training, he demonstrated independent manding at an average of 73% independence when using VOCA, and 57% independence when using PE (see Figure 3). Additionally, he demonstrated 100% independence for the VOCA during maintenance and 90% independence for maintenance sessions using PE. In terms of visual analysis, vertical distance and non-overlap of data paths, indicate that the VOCA device produced higher rates of independent manding.

Axel

Axel reached mastery criterion for the VOCA after two training sessions (see Figure 7). He required four training sessions to acquire PE. His overall percentage of independence was higher with VOCA than with PE, at 99% and 84%, respectively. Additionally, he averaged a higher percentage of independence during maintenance for the VOCA than for PE, with 86% and 100% independence, respectively. In terms of visual analysis, vertical distance between and non-overlap of data paths, during training, indicate that the VOCA produced higher rates of independent manding.

Aaron

Aaron reached mastery criterion for the VOCA after two training sessions (see Figure

11). He required seven training sessions to reach the same criterion for PE. His overall percentage of independent responding was higher for VOCA than for PE, with averages of 85% for VOCA and 59% for PE. However, he responded at a higher percentage of independence during maintenance for PE, at 93%, than for VOCA, at 86%. This may be attributed to the fact that there were five maintenance data sessions for VOCA and one for PE. In terms of visual analysis of the data, vertical distance and non-overlap between data points indicates that the VOCA device produced higher rates of independent manding.

Peter

Peter required fewer training sessions to reach mastery criterion for VOCA than for PE, requiring five and 10 sessions, respectively (see Figure 15). His overall percentage of independent responding was higher for VOCA, averaging 80% independence, than for PE, averaging 53% independence. Maintenance data were collected for four sessions with Peter for VOCA, where he averaged 98% independence. As described above, Peter did not maintain his ability to communicate using PE, with an average of 64% independence during the maintenance session. In terms of visual analysis of the data, vertical distance and non-overlap of data between data points indicates that the VOCA device produced higher rates of independent manding.

Rick

Rick required five training sessions to reach the mastery criterion for PE and 10 training sessions to reach the same criterion for the VOCA device (see Figure 19). Rick not only acquired PE at a faster rate, but he also averaged higher rates of independence across training and maintenance, with an average of 86% independence for PE and 59%

independence for VOCA. Maintenance data indicate that his ability to mand using PE did maintain as he averaged 95% independence across five maintenance sessions. Maintenance data were not collected for the VOCA device due to time constraints. In terms of visual analysis of the data, vertical distance and non-overlap of data paths indicates that PE produced higher rates of independent manding.

One possible explanation for Rick's slower acquisition rate for the VOCA is that the iPad requires that it be manipulated with only one finger. During training sessions, Rick would often rest his left hand on the device while attempting to manipulate the device with his right hand. Since both of his hands were on the device, and this would not evoke the digitized message. This increase in response effort for VOCA communication may account for his more readily acquiring PE communication.

Question 4

Which device do participants prefer when provided with the opportunity to respond with either PE or the VOCA device?

The results of the device preference assessment were mixed (see Figures 3, 7, 11, 15, and 19). All five participants clearly demonstrated preference for a device, four demonstrating preference for the iPad and one demonstrating preference for PE. These mixed results are consistent with the literature and may be attributable to the differences in acquisition rate across participants.

In Bock and colleagues (2005) investigation comparing PECS and VOCA acquisition in six, four-year-old boys with a developmental disability, a device preference was conducted following acquisition. The results of this assessment indicated that three of the six demonstrated preference for PECS and three demonstrated preference for VOCA (Book et al., 2005). In the Sigafoos et al. (2009) comparison of PE and VOCA in a 15-year-old boy diagnosed with Downs Syndrome, the device preference assessment indicated a slight preference for PE (Sigafoos et al., 2009). Finally, Son and colleagues (2006) comparison of PECS and VOCA, two of the three participants demonstrated preference for PECS and one participant demonstrated preference for VOCA (Son et al., 2006).

Joel

Joel demonstrated a clear preference for the iPad when presented with both the opportunity to mand with either PE or the iPad. He independently manded using the iPad at 85% independence and at 11% independence with PE. Joel responded during all opportunities to respond during the device preference assessment.

Axel

Axel demonstrated a clear preference for the iPad when presented with the opportunity to mand using either PE or the iPad. He independently manded using the iPad at 98% independence and at 2% independence with PE. Axel responded during all opportunities to respond during the device preference assessment.

Aaron

Aaron demonstrated a clear preference for the iPad when presented with the opportunity to mand with either PE or the iPad. He independently manded using the iPad at 94% independence and at 7% independence with PE. Aaron responded during all opportunities to respond during the device preference assessment.

Peter

Due to time constraints three device preference assessments were conducted with Peter. He demonstrated a preference for the iPad when paired with PE. He independently manded using the iPad at 78% independence and with PE at 4% independence. Peter did not respond during an average of 30% of opportunities to respond. During these trials, Peter was granted access to a random yet preferred item, following a latency of 30 seconds. Peter's decrease in independent responding during the device preference assessment may be attributed to environmental events such as a non-scheduled fire drill that occurred during the device preference assessment.

Rick

Rick demonstrated a clear preference for PE during the device preference assessment. He independently manded using PE at 89% independence and using the iPad at 12% independence. As previously described, for Rick it appeared that the use of the iPad required more response effort than the use of PE. Rick's acquisition of PE and clear preference for PE when compared to the VOCA device may be attributed to this increased response effort required for him to communicate using the VOCA device.

Question 5

What are the effects of the use of the iPad and application Proloqu2Go, and PE on collateral behaviors such as vocalizations and disruptive behaviors?

The results with regard to this research question were largely inconclusive (see Figures 4, 8, 16, and 20). Data were collected on both vocalizations and disruptive behaviors during baseline and training sessions. A vocalization included any audible utterance emitted by the participant. This included sounds (e.g., "ma"), words (e.g., "want"), or word approximations (e.g., "wan"). This did not include whining, crying, laughing, or sneezing. A behavior was considered disruptive if it interfered with the participant's or their peers' skill acquisition. Disruptive behaviors included aggression, self-injury, whining, crying, and stereotypy.

Vocalizations

Joel. Joel vocalized during 61% of trials during baseline. He vocalized during 94% of PE training trials and 72% of iPad training trials. He vocalized during 94% and 80% of PE and iPad maintenance trials, respectively. Overall, Joel vocalized during 73% of mand training sessions. His increase in vocalizations as compared to his peers may be the result of the use of tangible rather than edible reinforcers, as the remainder of participants were engaging in a response that was incompatible with the emitting of a vocalization.

Axel. Axel vocalized during 72% of trials during baseline. He emitted vocalizations during 17% of PE training trials and 33% of iPad training trials. He vocalized during 93% of PE and 29% of iPad maintenance trials. Overall, Axel emitted vocalizations during 32% of PE trials and 31% of iPad trials. As described in Chapter 4, Axel's decrease in vocalizations may be the result of the use of edible reinforcers, specifically candy (Swedish Fish).

Aaron. Aaron emitted vocalizations during 84% of baseline trials. He vocalized during 86% of PE and 60% of iPad training trials. He vocalized during 73% of PE and 79% of iPad maintenance sessions. Overall, Aaron emitted vocalizations during 85% of PE sessions and 73% of iPad sessions. His training and maintenance data are consistent with those data collected during baseline.

Peter. Peter emitted vocalizations during 62% of baseline trials. He vocalized during

64% of PE training and 43% of iPad training sessions. Peter emitted vocalizations during 93% of PE maintenance sessions and 27% of iPad maintenance sessions. Overall, Peter vocalized during 66% of PE sessions, consistent with baseline, and 35% of iPad sessions, a decrease when compared to baseline. Peter's decrease in vocalizations during iPad training may be the result of the use of edible reinforcers and the high rates of responding and reinforcement seen during iPad training, when compared to PE training.

Rick. Rick demonstrated vocalizations during 47% of baseline trials. He averaged 64% of PE training trials and 51% of iPad training trials with vocalizations, an increase from baseline. During PE maintenance Rick averaged 29% of trials with vocalizations. No maintenance data were collected for the iPad. The decrease in Rick's vocalizations during PE maintenance may be the result of the use of edible reinforcers and the high rates of responding and reinforcement during PE maintenance.

General Conclusions. For one participant, Joel, an increase in vocalizations was demonstrated. For one participant, Aaron, vocalizations pre-and-post training were consistent with that of baseline. For one participant, Axel, there was a decrease in vocalizations. For two participants, Rick and Peter, a decrease was evident only for the device that they acquired more quickly. These results do not indicate that the use of PE or a VOCA device may decrease the rate at which an individual emits vocalizations; however, they do suggest that the use of edible reinforcers may lead to an overall decrease in vocalizations. This can be inferred as Joel who did not receive any edible reinforcers demonstrated a clear increase in vocalizations, while the others did not. Furthermore, for Peter and Rick, the decrease in vocalizations was only evident for the device with which they were demonstrating the most independence, suggesting that eating or drinking edible reinforcers, which is incompatible with speech, may have affected their frequency of speech.

These results are consistent with Sigafoos and colleagues (2003) who investigated the effects of mand training using VOCA on vocalizations. In this study three children diagnosed with autism were taught to communicate using a VOCA device, while frequency data were collected on vocalizations. Results of this investigation indicated that while communication training produced a minimal effect on vocalizations, each participant did acquire the ability to independently mand using VOCA (Sigafoos et al., 2003).

Disruptive Behaviors

The literature has demonstrated the effectiveness of mand training at decreasing disruptive behaviors found to function for positive reinforcement in the form of access to preferred items and activities. For example, Durand (1999) evaluated the effectiveness of VOCA training to decrease problem behavior in five children diagnosed with autism. During this investigation, the participants acquired the ability to mand for a preferred item or activity using a VOCA device. Results of this investigation demonstrated that the acquired communicative repertoire was effective in decreasing the occurrence of problem behavior from a rate of 25-100, 3.5-minute intervals to a rate of 0-5, 3.5-minute intervals.

The results of this investigation were not as conclusive (see Figures 5, 9, 13, 17, and 21). Data were collected on disruptive behaviors using a 30-second partial interval recording system. As such, if a disruptive behavior was demonstrated at any point during the 30-second interval, the interval was scored. Prior to baseline data collection, the classroom teacher identified disruptive behaviors for each participant and their supposed function. A functional behavior assessment was not conducted.

Joel. Joel exhibited disruptions during 47% of 30-second intervals during baseline. He demonstrated disruptions during 11% of PE training intervals and 37% of iPad intervals. During maintenance, Joel demonstrated disruptions during 17% of PE intervals and 43% of iPad training intervals. Overall, Joel demonstrated disruptions during 12% of PE intervals and 33% of iPad intervals. These disruptions included whining, crying, and falling off of his chair. There was an overall decrease in Joel's disruptions during and post training; however, this decrease was greater during PE training and maintenance.

Axel. Axel's disruptive behavior included whining, crying, and self-injury, which was topographically defined as banging his head on the floor. Axel exhibited disruptions during 20% of baseline intervals. He demonstrated disruptions during 5% of intervals during PE training intervals and 4% during iPad training intervals. During maintenance, Axel demonstrated disruptions during 13% of iPad intervals. He did not demonstrate any disruptions during PE maintenance. Overall, Axel's demonstration of disruptions decreased to 7% intervals for PE and 9% of intervals for iPad training and maintenance.

Aaron. Aaron's disruptive behavior included crying and aggression (hitting) of the instructor. He demonstrated disruptions during 8% of baseline intervals. Aaron exhibited disruptive behavior during 5% of PE and 7% of iPad training intervals. During maintenance, Aaron demonstrated disruptions during 20% of iPad intervals and 18% of PE intervals. Overall, there was a slight decrease during PE training and maintenance at 5% and an increase during iPad training and maintenance at 16% of intervals including disruptions.

Peter. Peter's disruptive behavior included crying. He demonstrated disruptions during 2% of baseline intervals. He demonstrated disruptions during 4% of intervals during iPad training and 2% of intervals during iPad maintenance. Peter did not demonstrate any disruptions during PE training or maintenance. Overall, Peter's demonstration of disruptive behavior was consistent across baseline, training, and maintenance sessions.

Rick. Rick's disruptive behavior included whining and aggression (hitting) of the instructors. He demonstrated disruptions during 25% of baseline intervals. He exhibited disruptive behavior during 18% of PE intervals and 12% of iPad intervals. He did not demonstrate disruptive behaviors during PE maintenance trials. Maintenance data were not collected for the iPad. Overall, Rick's demonstration of disruptive behaviors decreased from 25% of intervals during baseline to 9% of intervals for PE training and maintenance and 12% of iPad training intervals.

General Conclusions. For two participants a general decrease in the demonstration of disruptive behaviors is indicated. For one participant there was no change in disruptive behaviors. For the remaining three participants mixed results are evident. These results are not consistent with the literature; however, given that the function of these disruptions was not determined prior to the introduction of mand training, it is not surprising that the results are mixed. That is, one would not expect a decrease in disruptive behavior, unless that behavior was first determined to function for positive reinforcement, or for access to preferred items and activities, and reinforcement for manding as a functional communicative response was provided while problem behaviors were placed on extinction.

Question 6

Are the use of the iPad and PE a socially valid alternative for teachers of individuals requiring AAC?

A survey was distributed to one behavior analyst, one classroom teacher, and three paraprofessionals to measure the social validity of the training procedures and the augmentative and alternative devices, PE and the iPad with the application Proloqu2Go (see Table 3). As a group, the classroom staff stated that the iPad was a very acceptable communication tool and they were very likely to incorporate communication training using the iPad into their classroom routine. Additionally, they were very likely to recommend communication training using the iPad in the future. Conversely, they found PE to be somewhat acceptable as a communication tool; however, they were likely to incorporate communication training using PE into their classroom routine and very likely to recommend its use in the future. There are several implications to these responses.

First, use of AAC for mand training, was found to be acceptable and the classroom staff reported that they were likely to incorporate mand training, using both PE and the VOCA device, in their classroom routine. This is important as there was a clear relation between the contriving of mands and the acquisition of a mand repertoire, within the current study. This is evident through the training data depicted in Figures 2, 6, 10, 14, and 18. Two of the participants acquired the ability to mand independently using the iPad, independently after only two training sessions. This may suggest that their scores on the *Verbal Behavior-Milestones Assessment and Placement Program* barriers assessment was not the result of an absent or weak mand repertoire, but the lack of the appropriate contriving of opportunities to mand. Additionally, the responses indicate that the classroom staff is more likely to incorporate mand training using the iPad in their classroom when compared to PE. Again, this is important given that exposure to the device is necessary for its acquisition.

Finally, based on daily observations of the training, the classroom staff found that the iPad was a slightly more acceptable communication tool when compared to PE. These responses may be attributable to the response effort required by the instructor to develop a PE system. To develop a picture depicting a preferred item or activity for use with PE one must (a) acquire a picture of the item or activity, (b) print the picture of the item or activity, (c) cut out the picture of the item or activity, (d) laminate the picture of the item or activity, and (e) secure the picture of the item or activity with Velcro. This process is time consuming and laborious. To develop a picture depicting a preferred item or activity for the iPad one must (a) go to edit on the device, (b) press the "add" button, (c) type in the name of the item, and (d) add a picture of the item using either the preloaded pictures or by using the device's camera. This process can be completed in a matter of seconds and requires no additional devices (e.g., computer, printer, laminator, etc.). As such, an additional benefit of the iPad is that it allows the instructor to quickly follow the motivation of the learner. Given the increased response effort required for the development and maintenance of PE, on the part of the instructor, it is not surprising that classroom staff found the iPad more acceptable and were more likely to incorporate its use in their classroom. However, although the classroom involved in this study did have access to an iPad, with the application Proloqu2Go, iPads are costly and may not be available in a variety of educational settings.

Limitations

Device

A limitation of the current study is the availability of VOCA devices. The VOCA in the current study was the iPad, version two, with the application Proloqu2Go. In the setting where the current study took place, an iPad version two, with the application Proloqu2Go was available; however, this device is costly. According its manufactures, an iPad version two costs $499 and the application Proloqu2Go costs $187.99, for a total cost of $686.99. Alternatively, use of PE is relatively inexpensive, once the initial purchase of a computer, laminator, and Velcro are made.

Stimulus Preference Assessment

The use of a multiple stimulus without replacement preference assessment was a limitation of this study. Prior to the conducting of the preference assessment, the classroom teacher was asked to indicate possible reinforcers for each student. For four of the five students, social reinforcers (e.g., tickling, high-fives) were identified. Given that the participants did not have the ability to make choices using pictures, these items were not included in the stimulus preference assessment. As such, the items used for mand training may not have been as motivating as those social reinforcers and may have affected the acquisition rates of the communicative repertoires.

Participants

Though the participants did not have formal training using PE, they did have previous exposure to the selection and exchange of a picture, through the use of visual schedules within the classroom routine. This may have affected the acquisition rates of the participants.

Additionally, three of the participants received 26.5 hours of classroom instruction, whereas two of the participants only received 10 hours of classroom instruction. This allowed for more training opportunities with three of the participants, as training was conducted during classroom centers or free playtime, which occurred an average of five times per full day of instruction. The unequal instructional time allowed for three participants to receive more exposure to the training procedures, which may have affected the acquisition rates.

Setting for Training

The setting for this study was an unused corner of the participants' classroom and the training sessions were conducted in a discrete manner. Given that the use of natural environment teaching (NET) has been demonstrated as effective in the acquisition of a mand repertoire (i.e., Schepis et al., 1998), the setting for the training may be a limitation to generalization of the acquired repertoire.

Training Sessions

For each participant multiple training sessions occurred per instructional day across both PE and the iPad. This may have affected acquisition rates, given the carry-over effects that are often observed while teaching manding using multiple modalities. To limit this possible effect, the presentation of the devices was randomized and alternated across participants.

Generalization Assessment & Training

A generalization assessment and procedures to teach generalization were not included in this study, due to time constraints. This limits external validity of the results as it cannot be assured that the acquired repertoires did, in fact, generalize to the natural environment.

Discrimination Training

Training that would have included discrimination between pictures was not included in the research design and is a limitation, as the participants acquired the ability to mand only with one picture. As with the generalization training, discrimination training was not included due to time constraints. However, all five participants did acquire the topography necessary for manding across both devices, as is consistent with Phase 1 of the PECS protocol (Frost & Bondy, 2002).

Collateral Effects

Vocalizations. As previously described, the use of edibles may have affected the rate of vocalizations during training and maintenance. Therefore, future investigations as to the affects of mand training using AAC, on the rates of vocalizations should focus on use of non-edible reinforcers. An additional factor and limitation of this study is that reinforcement for manding was contingent upon use of the AAC, not vocalizations. That is, no reinforcement occurred for vocalizations, which could have affected their rate of occurrence. Finally, stable responding during baseline, with regard to vocalizations was not achieved, and therefore limits the conclusions that can be made within the current study.

Disruptive Behaviors. A functional behavior assessment was not conducted prior to the start of the study. As such, a decrease in three of the participants' disruptive behavior cannot be definitively attributable to the acquisition of the mand repertoire. Additionally, for those participants for whom no change was evident or an increase in disruptive behavior was demonstrated, this may be the result of extraneous reinforcement that may have occurred as the result of the training procedure. For example, during the baseline procedures, participants were granted access to a preferred item following 30 seconds, if a disruptive behavior occurred within the 30 second interval, the preferred item was still delivered. That is, by the very nature of the research design, the procedures may have provided reinforcement for the demonstration of disruptive behavior.

Future Research

As the results of this study indicate that the use of the iPad and application Proloqu2G0 are an effective augmentative and alternative communication aid, and that rates of acquisition using this device are comparable to those of PE, future research should extend this research using the iPad as a VOCA. Such research should incorporate a generalization assessment and training procedure to address the limitations of this research. Additionally, extensions should address discrimination training of the acquired mand repertoires with multiple pictures and extended vocabularies.

To evaluate the effects of mand training using the iPad on collateral effects, future research endeavors should include a functional behavior assessment in the research design. Inclusion of a functional behavior assessment could facilitate the design of mand training procedures that address problem behavior functions and decrease the demonstration of disruptive behaviors. Additionally, vocal utterances could be made functional in that reinforcement could occur for productions of words and word approximations during mand training, at least for participants who engaged in some degree of vocal production during training.

Additionally, the use of naturalistic training procedures should be included in future research. Given that manding is a repertoire that does not occur in isolation but rather across all environments, use of naturalistic teaching strategies (i.e., NET) may increase generalization of the acquired skill. Furthermore, use of NET may increase the likelihood of the demonstration of a mand during naturally occurring opportunities, rather than an artificial teaching method that relies on highly contrived opportunities to respond.

Finally, given the small sample size of the current study and the limitations of the research design, future replications comparing acquisition rates between PE and the iPad as a VOCA are needed. Additionally, given the literature that supports its effectiveness (e.g., Yoder & Liberman, 2010; Gordon et. al., 2011; Ganz & Simpson, 2004, etc.), future research should compare the acquisition of manding using the PECS protocol and the iPad as a VOCA.

Summary

Despite the limitations presented, the use of a training procedure employing a constant time delay with full-physical prompts was effective in the acquisition of a mand repertoire in all participants across both PE and the VOCA. For three participants the iPad as a VOCA was acquired more readily than PE. For one participant PE was acquired more readily than the VOCA device; however, the VOCA produced more independent responding, across all training and maintenance sessions. One participant acquired PE more quickly than the VOCA. Regarding preference four participants demonstrated a preference for the iPad as a VOCA, while one participant exhibited preference for PE. These differences in responding may be attributable to the heterogeneous nature of autism and/or the differing response effort required for use of each respective device.

With respect to collateral effects, the data were largely inconclusive. For one participant there was an overall increase in vocalizations, for one participant there was an overall decrease in vocalizations and for the remaining three there was no significant change in their rate of vocalizations during or following communication training. These data may be the result of either the use of edible reinforcers or the lack of reinforcement for vocalizations. Regarding disruptive behaviors, an overall decrease in the occurrence was seen for two participants, while for the remaining three, the rates of occurrence did not change significantly following communication training. As previously noted, it is not expected that problem behaviors would decrease because the function of disruptive behaviors was not addressed through intervention. Finally, the classroom staff in general reported that the use of the iPad as a VOCA was not only an acceptable communication strategy, but that they were likely incorporate such training into their classroom routine and to recommend its use in the future. These implications are significant as it is evident that there is a clear relation between the contriving of mands and the rate at which a learner acquires the ability to mand. As such, if teachers are more likely to contrive mands using the iPad, the students are more likely to acquire a mand repertoire.

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APPENDIX A

Baseline Data Sheet

Student: ______________________ Date: _____________ Start/End time: _______/______

Observer: _______________ Session: _____________ Interobserver agreement: Y / N

Item:	PE	Location	iPad	Location	Vocalization	Interval		Topography
1.	Y / N	L / R	Y / N	L / R	Y / N	:30	Y /N	
2.	Y / N	L / R	Y / N	L / R	Y / N	1:00	Y /N	
3.	Y / N	L / R	Y / N	L / R	Y / N	1:30	Y /N	
4.	Y / N	L / R	Y / N	L / R	Y / N	2:00	Y /N	
5.	Y / N	L / R	Y / N	L / R	Y / N	2:30	Y /N	
6.	Y / N	L / R	Y / N	L / R	Y / N	3:00	Y /N	
7.	Y / N	L / R	Y / N	L / R	Y / N	3:30	Y /N	
8.	Y / N	L / R	Y / N	L / R	Y / N	4:00	Y /N	
9.	Y / N	L / R	Y / N	L / R	Y / N	4:30	Y /N	
10.	Y / N	L / R	Y / N	L / R	Y / N	5:00	Y /N	
11.	Y / N	L / R	Y / N	L / R	Y / N	5:30	Y /N	
12.	Y / N	L / R	Y / N	L / R	Y / N	6:00	Y /N	
13.	Y / N	L / R	Y / N	L / R	Y / N	6:30	Y /N	
14.	Y / N	L / R	Y / N	L / R	Y / N	7:00	Y /N	
15.	Y / N	L / R	Y / N	L / R	Y / N	7:30	Y /N	
16.	Y / N	L / R	Y / N	L / R	Y / N	8:00	Y /N	
17.	Y / N	L / R	Y / N	L / R	Y / N	8:30	Y /N	
18.	Y / N	L / R	Y / N	L / R	Y / N	9:00	Y /N	

APPENDIX B

Training Data Sheet

Device:___________________

Student: _______________________ Date: ______________ Start/End time: ________/_______

Observer: ________________ Session: ______________ Interobserver agreement: Y / N

Item:	Response	Vocalization
1.	I / FPP	Y / N
2.	I / FPP	Y / N
3.	I / FPP	Y / N
4.	I / FPP	Y / N
5.	I / FPP	Y / N
6.	I / FPP	Y / N
7.	I / FPP	Y / N
8.	I / FPP	Y / N
9.	I / FPP	Y / N
10.	I / FPP	Y / N
11.	I / FPP	Y / N
12.	I / FPP	Y / N
13.	I / FPP	Y / N
14.	I / FPP	Y / N
15.	I / FPP	Y / N
16.	I / FPP	Y / N
17.	I / FPP	Y / N
18.	I / FPP	Y / N
19.	I / FPP	Y / N
20.	I / FPP	Y / N
21.	I / FPP	Y / N
22.	I / FPP	Y / N
23.	I / FPP	Y / N
24.	I / FPP	Y / N
25.	I / FPP	Y / N

Interval	Disruption	Topography
:30	Y /N	
1:00	Y /N	
1:30	Y /N	
2:00	Y /N	
2:30	Y /N	
3:00	Y /N	
3:30	Y /N	
4:00	Y /N	
4:30	Y /N	
5:00	Y /N	
5:30	Y /N	
6:00	Y /N	
6:30	Y /N	
7:00	Y /N	
7:30	Y /N	
8:00	Y /N	
8:30	Y /N	
9:00	Y /N	
9:30	Y /N	
10:00	Y /N	

APPENDIX C

Device Preference Data Sheet

Student: ______________________ Date: _____________ Start/End time: _______/______

Observer: _______________ Session: _____________ Interobserver agreement: Y / N

Item:	PE	Location	iPad	Location	Vocalization	Interval		Topography
1.	Y / N	L / R	Y / N	L / R	Y / N	:30	Y /N	
2.	Y / N	L / R	Y / N	L / R	Y / N	1:00	Y /N	
3.	Y / N	L / R	Y / N	L / R	Y / N	1:30	Y /N	
4.	Y / N	L / R	Y / N	L / R	Y / N	2:00	Y /N	
5.	Y / N	L / R	Y / N	L / R	Y / N	2:30	Y /N	
6.	Y / N	L / R	Y / N	L / R	Y / N	3:00	Y /N	
7.	Y / N	L / R	Y / N	L / R	Y / N	3:30	Y /N	
8.	Y / N	L / R	Y / N	L / R	Y / N	4:00	Y /N	
9.	Y / N	L / R	Y / N	L / R	Y / N	4:30	Y /N	
10.	Y / N	L / R	Y / N	L / R	Y / N	5:00	Y /N	
11.	Y / N	L / R	Y / N	L / R	Y / N	5:30	Y /N	
12.	Y / N	L / R	Y / N	L / R	Y / N	6:00	Y /N	
13.	Y / N	L / R	Y / N	L / R	Y / N	6:30	Y /N	
14.	Y / N	L / R	Y / N	L / R	Y / N	7:00	Y /N	
15.	Y / N	L / R	Y / N	L / R	Y / N	7:30	Y /N	
16.	Y / N	L / R	Y / N	L / R	Y / N	8:00	Y /N	
17.	Y / N	L / R	Y / N	L / R	Y / N	8:30	Y /N	
18.	Y / N	L / R	Y / N	L / R	Y / N	9:00	Y /N	

APPENDIX D

Social Validity Survey

1. How clear was your understanding of the training procedure?

1	2	3	4	5	6	7
Not clear at all			Somewhat clear			Very clear

2. How acceptable did you find the use of the iPad as a communication tool?

1	2	3	4	5	6	7
Not at all acceptable			Somewhat acceptable			Very acceptable

3. How acceptable did you find the use of Picture Exchange as a communication tool?

1	2	3	4	5	6	7
Not at all acceptable			Somewhat acceptable			Very acceptable

4. How likely are you to incorporate communication training using the iPad into your classroom routine?

1	2	3	4	5	6	7
Very likely			Somewhat likely			Not at all likely

5. How likely are you to incorporate communication training using Picture Exchange into your classroom routine?

1	2	3	4	5	6	7
Very likely			Somewhat likely			Not at all

6. How effective did you find the training procedure?

1	2	3	4	5	6	7
Not at all effective			Somewhat effective			Very likely effective

7. How likely is it that you would recommend communication training using the iPad in the future?

1	2	3	4	5	6	7
Not at all likely			Somewhat likely			Very likely

8. How likely is it that you would recommend communication training using the Picture Exchange in the future?

1	2	3	4	5	6	7
Not at all likely			Somewhat likely			Very likely

APPENDIX E

Procedural Fidelity

Researcher:

Date:

Baseline	**1** **2** **3** **4** **5** Always Often Sometimes Never N/A	**Comments**
I conducted the session for 10 minutes?	**1** **2** **3** **4** **5** Always Often Sometimes Never N/A	
I placed the items within view and out of reach?	**1** **2** **3** **4** **5** Always Often Sometimes Never N/A	
The iPad and PE materials available?	**1** **2** **3** **4** **5** Always Often Sometimes Never N/A	
I interacted with child only in response to independent mands and disruptive behavior?	**1** **2** **3** **4** **5** Always Often Sometimes Never N/A	
I presented a random item from array to child after 30 seconds of latency	**1** **2** **3** **4** **5** Always Often Sometimes Never N/A	
I allowed access to random item for 10-15 seconds?	**1** **2** **3** **4** **5** Always Often Sometimes Never N/A	
I did not use social praise	**1** **2** **3** **4** **5** Always Often Sometimes Never N/A	

Procedural Fidelity

Researcher:
Date:

Training	**1 2 3 4 5**	**Comments**
	Always Often Sometimes Never N/A	
I presented 3 preferred items as reflected from MSWO?	**1 2 3 4 5** Always Often Sometimes Never N/A	
I used the child's reach to determine the item to be used for trial?	**1 2 3 4 5** Always Often Sometimes Never N/A	
I placed the device in front of child immediately following the reach response?	**1 2 3 4 5** Always Often Sometimes Never N/A	
I used 2X2 pictures in field of one is on the device?	**1 2 3 4 5** Always Often Sometimes Never N/A	
I provided a 5 second opportunity for the participant to mand independently?	**1 2 3 4 5** Always Often Sometimes Never N/A	
I employed full-physical prompt after 5 seconds?	**1 2 3 4 5** Always Often Sometimes Never N/A	
I granted the child is access to item for 10-15 seconds?	**1 2 3 4 5** Always Often Sometimes Never N/A	
I did not use any verbal prompting?	**1 2 3 4 5** Always Often Sometimes Never N/A	
I conducted a 10 minute session?	**1 2 3 4 5** Always Often Sometimes	

	Never N/A	
I conducted the session in the classroom?	**1** **2** **3** **4** **5** Always Often Sometimes Never N/A	
I contrived 12-15 trials per session?	**1** **2** **3** **4** **5** Always Often Sometimes Never N/A	
I did not use social praise?	**1** **2** **3** **4** **5** Always Often Sometimes Never N/A	