Communicative abnormalities are common symptoms of individuals who have autism spectrum disorders. Many children with autism fail to develop functional speech. This study addressed the augmentative and alternative communication (AAC) needs of children who have a diagnosis on the autism spectrum and who possess deficits in communicative behaviors, as well as the potential of AAC strategies to promote vocal responding. The effects of Proloquo2Go on the Apple iPad were evaluated in relation to the requesting skills of the participants. Proloquo2Go is an AAC system that utilizes symbols, visual supports, and a voice output component. Participants were taught to utilize the system in order to request for preferred items. Following an iPad training phase, a prompt delay procedure was implemented to promote vocal responding. The study utilized a multiple baseline design across participants with multiple phases.

Gina Gavrilis
May 2013
EVALUATING IPAD TECHNOLOGY AS AN AUGMENTATIVE AND ALTERNATIVE COMMUNICATION DEVICE AND ITS EFFECTS ON VOCAL COMMUNICATION SKILLS

by

Gina Gavrilis

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts in Psychology in the College of Science and Mathematics California State University, Fresno

May 2013
APPROVED

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CHAPTER 1: INTRODUCTION

Autism spectrum disorders are a class of pervasive developmental psychopathologies that are defined by various behavioral deficits and excesses (Schreibman, 2005). Characteristics of autism include atypical development in the areas of cognition, socialization, communication, and behavior (Centers for Disease Control and Prevention [CDC], 2010). Children with autism often have difficulties developing normal social relationships, functional speech, motor skills, and basic learning skills. In addition to this, many children with autism engage in excessive problem behaviors. The combinations of symptoms that manifest in affected individuals vary widely and are observed at various levels of severity (CDC, 2010).

Severe speech and communicative impairments are common in children and adults with autism. In fact, approximately one third to one half of these individuals do not develop functional speech (CDC, 2010; Schreibman, 2005). Many children with autism, who do gain speech and language, develop the skill later than their typically developing peers and often exhibit pathological speech characteristics, such as odd intonation or echolalia (Schreibman, 2005; Tager-Flusberg, Paul, & Lord, 2005). Communication delays are often linked to other core deficits of autism, such as socialization and behavior (Schreibman, 2005). The development of functional communication can often help to improve or eliminate these other common deficits (Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002). For example, communication skills are often considered prerequisites for many social skills. In addition, many problematic behavioral excesses can be linked to communication delays. A number of research protocols have focused on training communication skills as replacement behaviors for
behavioral excesses, such as aggression, tantrums, and self-injury (Carr & Durand, 1985; Goldstein, 2002). The connection between communication skills and other core deficits of autism demonstrate the importance of communicative development.

Many individuals with autism fail to develop speech that is functional within their environments (Schreibman, 2005). While communication interventions targeting speech can be successful, other communication methods often become necessary. Augmentative and alternative communication (AAC) methods and devices allow for individuals with limited verbal skills to communicate. These methods include gestures, manual signs, picture or symbol systems, and computer systems (Sigafoos, 2010).

Effective and evidence-based interventions using AAC systems have been successful for people with physical and developmental disabilities, including those with autism (Sigafoos, 2010). However, many AAC systems have limitations that interfere with full communication (Mirenda, 2003). Limitations include prerequisite skill demands, the cost and size of devices, and limited access to a variety of communicative partners. Current limitations of AAC systems demonstrate a need for more AAC research and new AAC systems.

The Apple iPad and other Apple devices can function as AAC systems when equipped with specialized applications. Proloquo2Go is an application that can be downloaded onto Apple devices. This application turns the Apple iPad into an AAC system that utilizes touch screen technology, symbols, and voice-output. The iPad and Proloquo2Go system addresses some of the limitations of other AAC methods; the system may benefit individuals with limited communication skills (Sennott & Bowker, 2009).
Providing limited or nonverbal individuals with a method of communication is crucial. At the same time, encouraging vocal communication is essential for individuals who still have the potential to develop speech. Interventions focused on verbal speech may still be important for individuals who use AAC systems (Carbone, Sweeney-Kerwin, Attanasio, & Kasper, 2010). Prompt delay procedures can be incorporated into interventions that involve AAC to promote speech (Carbone et al., 2010; Charlop, Schreibman, & Thibodeau, 1985; Tincani, Crozier, & Alazetta, 2006). The iPad and Proloquo2Go system and techniques, such as the prompt delay, may work together to emit vocal responding in individuals with autism.
A plethora of behavioral interventions have been developed to target communicative behaviors in children with autism (Landa, 2007; Virues-Ortega, 2010). Vocal speech is typically the primary goal of such interventions. Interventions targeting expressive language include, but are not limited to, the following: discrete-trial training (Lovaas, 1987), naturalistic teaching techniques (Hancock & Kaiser, 2006), applied verbal behavior interventions (Sundberg & Michael, 2001), and time-delay procedures (Charlop et al., 1985). Despite the implementation of evidence-based interventions, many children are unsuccessful and still fail to develop functional speech. When this occurs, it is essential to provide individuals with an alternative communication modality that does not require speech skills (Sigafoos, 2010).

Other functionally equivalent behaviors are often used when speech is underdeveloped. Many children with speech delays rely on nonvocal communication. Many terms have been used to describe nonvocal communicative behaviors including potential communicative acts, prelinguisitic or preverbal behavior, and nonsymbolic behavior. These terms all describe behaviors that are nonverbal, but expressive of communicative intent. Nonvocal communication encompasses a variety of behaviors including body movements, face or eye movement, breathing, challenging behaviors, stereotypic behaviors, and symbolic forms (Keen, Sigafoos, & Woodyatt, 2001). Thomas, Lafasakis, and Sturmey (2010) made an additional classification for nonverbal communicative behaviors. These behaviors were divided into two categories: immature and appropriate (Thomas et al., 2010). Immature communicative behaviors include reaching, grabbing, yelling, or leading behaviors, whereas appropriate communicative
behaviors include pointing and looking. These behaviors are functionally equivalent; however, the immature responses lack full communicative effect on the listener (Keen et al., 2001). Appropriate communicative behaviors facilitate communication in a more suitable and socially significant manner (Thomas et al., 2010).

In addition to the immature and appropriate nonverbal communicative behaviors outlined by Thomas et al. (2010), other appropriate communication methods are available to individuals in need. Augmentative and alternative communication (AAC) strategies are appropriate nonverbal methods that have been developed in order to compensate for speech and language deficits. AAC strategies are communication methods that do not require the use of speech. These methods can be used for individuals with developmental and physical disabilities to either augment unintelligible speech or to operate as an individual’s primary communication method (Sigafoos, 2010). Possible AAC methods include gestures, manual signs, graphic symbols, electronic devices, and speech-generating devices (Mirenda, 2003; Sigafoos, 2010). These communication strategies are used to lessen the disadvantages faced by individuals who lack effective communication. AAC can be more acceptable and functional when compared with immature nonverbal communicative behaviors; individuals using AAC can develop a more complete verbal repertoire, including the development of verbal operant behaviors (Sundberg & Michael, 2001). Children with autism who lack functional speech are candidates for AAC interventions (Mirenda, 2003).

Many children with autism are trained to use manual signs in order to communicate; signs have been acquired successfully and serve the same communicative function as vocal speech for some individuals (Mirenda, 2003; Tincani, 2004). Manual signs are a form of unaided AAC; signs are performed
using the individual’s hands and do not require additional equipment (Mirenda, 2003). Manual signs used by individuals with autism are typically borrowed or modified from the community’s sign language, such as American Sign Language, and are symbolic in nature. Children with autism have learned to label and request items in the environment using manual signs; this skill has been demonstrated to occur spontaneously and to generalize across communicative partners and settings (Carr, Binkoff, Kologinsky, & Eddy, 1978; Carr & Kologinsky, 1983).

Manual sign training is commonly used when teaching nonverbal children to request or mand for items or activities available in the environment. In a comparative study, Tincani (2004) examined the acquisition of mands as a result of either picture exchange communication system (PECS) training or manual sign training (Tincani, 2004). These communication systems were taught by using similar prompting and fading procedures. Children were taught to use both systems to request preferred items. Results did not suggest a superior communication system; that is, one participant initiated more independent mands during sign language training, while one participant initiated more independent mands during PECS training. Thus, manual sign training can be beneficial for some individuals. Manual signs can be taught to children with autism and are prompted more easily than verbal responses; signs can also be modified for the individual based on specific preexisting skill sets (Tincani, 2004).

In addition to manual sign training, manual signs can be used as a part of total communication interventions. Total communication interventions utilize manual signs as a component of communication training (Goldstein, 2002; Mirenda, 2003; Sisson & Barrett, 1984). Total communication typically combines manual signs and vocal responses. This method has been successful in teaching children to sign and to vocalize single-words and short sentences. This method
has been found to be more successful in communication training when compared with oral communication training alone; these interventions have been effective for children with autism (Goldstein, 2002; Mirenda, 2003; Sisson & Barrett, 1984). Many studies analyzing the effects of total communication training have not thoroughly explored manding behaviors or spontaneous communication. However, the intervention can train some children to sign, vocalize, or both (Mirenda, 2003).

Despite the success and benefits of manual sign and total communication training, many individual are unable to use these methods successfully. Manual sign use requires adequate motor functioning (Seal & Bonvillian, 1997). Various hand shapes and hand movements must be created in order for the signs to possess communicative value. This is problematic for individuals with autism who also possess fine motor deficits (CDC, 2010). A lack of prerequisite fine motor skills may make learning manual signs difficult (Seal & Bonvillian, 1997). Tincani’s (2004) participant who did not utilize manual sign at high rates began the study with weak hand-motor imitation skills. In addition, Seal and Bonvillian (1997) found high correlations between accurate sign formation and fine motor age scores of children with autism; the children’s manual sign vocabulary size was also correlated with motor skill (Seal & Bonvillian, 1997). Another important factor to consider when using manual sign is the potential for communicative partners (Mirenda, 2003). A child who uses manual signs is limited and can only communicate with peers and adults who are able to understand manual signs.

Picture-exchange systems are another commonly used AAC method for individuals with autism and related developmental disabilities. The Picture Exchange Communication System (PECS) is a picture-exchange, AAC method used to teach functional communication when functional speech is absent or
limited (Bondy & Frost, 1994, 2001; Charlop-Christy, et al., 2002; Hart & Banda, 2010). It is a form of aided AAC; PECS requires additional materials outside the individual’s body (Mirenda, 2003). The system involves a series of training steps that utilize picture cards and an exchange with a communicative partner. Children are taught to pick up a picture card with an image that corresponds to a desired item, activity, or idea; the picture card must then be given to a communicative partner to complete the communication exchange. Children can produce single-words, phrases, and sentences with the PECS system. In addition, PECS can allow children to make appropriate requests, comments, and answers to questions.

The PECS system has been praised for its effectiveness, attention to the social aspects of communication, and ease of training (Hart & Banda, 2010). Typically, the system can be taught to trainers and children rather rapidly and at a low cost (Bondy & Frost, 1994). This communication method is also more universally understood by a variety of communicative partners. In addition to this, PECS does not require complex prerequisite skills, such as eye contact, attending, and fine motor movements. When compared with manual sign training, Tincani (2004) found that PECS was more successful with one participant, whereas manual sign was more successful with the other. The child who performed best using the PECS system began the study with weak motor skills (Tincani, 2004). Lacking certain prerequisite skills may interfere with learning communication systems, such as manual sign. Communication systems, like PECS, that require few complex prerequisites and that can generalize to natural conditions work to benefit individuals with a variety of developmental delays (Bondy & Frost, 1994, 2001; Hart & Banda, 2010).

Despite the many advantages of PECS, limitations still exist. The PECS system relies on the use of picture cards; the creation of these cards requires effort
from the care provider or clinician and can be lost or damaged by the child utilizing the system (Bondy, 2001; Flippin, Reszka, & Watson, 2010). Care providers and clinicians may choose to organize the picture cards into a communication book for ease of use, protection, and organization. However, this too may be restricting for a child who must carry the communication book in order to possess functional communication (Flippin et al., 2010). In addition, the communication book created for an individual may not contain all possible responses for a variety of environments; if a picture card does not exist in the book, a care provider or clinician must create the card at a later time (Bondy, 2001; Flippin et al., 2010). Therefore, communication is momentarily impaired and other communication strategies must be relied upon until the new response is added to the system. As more response options are added to the system, PECS becomes more difficult to use efficiently. A communication book with many picture cards may become difficult to manage. Some communication books include over 100 icons (Bondy, 2001); searching through many picture cards for a single response is time consuming and may become impractical. As the number of icons in a communication book increases, many individuals turn to other AAC methods, such as electronic devices (Bondy, 2001).

Electronic AAC devices are aided communication systems that require the use of a specialized device (Mirenda, 2003). Many electronic devices include a voice component to emulate vocal speech. Such devices are termed voice output communication aids (VOCAs); a variety of devices are available for use by children with autism and related disabilities. VOCAs utilize graphic symbols, which can be selected by a user to convey a desired message. The symbol or message selected produces a synthetic or digitized speech output, thus communicating the message to any present listener (Mirenda, 2003). VOCAs can
be used for a number of communicative behaviors including requests, answering questions, and social commenting (Schepis, Reid, Behrmann, & Sutton, 1998).

VOCAs have been used with children with autism to promote an increase in communicative interactions (Schepis et al., 1998; Son, Sigafoos, O’Reilly, & Lancioni, 2006). Schepis et al. (1998) used naturalistic teaching strategies during snack and play routines to teach four children with autism to use a VOCA. All participants showed an increase in the frequency of communicative behaviors using the VOCA. Similar results were found for one participant in a comparative study conducted by Son et al. (2006). This study compared two types of AAC systems: a picture-exchange system and a VOCA. The three participants were taught both methods in order to request items. Increases in communicative behaviors occurred for both systems across all participants. However, preference assessments with a focus on the communication methods indicated one child’s preference for the VOCA, rather than the picture-exchange system (Son et al., 2006).

Like other augmentative and alternative communication strategies, VOCAs have advantages and disadvantages. The voice-output component of VOCAs is often a benefit for individuals using the device; this feature transforms the communicative interaction into a more natural conversation during which the communicative partner can simply listen to the communicator. However, voice-output technology does not imitate natural speech. Such systems have issues related to intelligibility, vocal quality, volume control, and voice options (Smith, 2005). VOCAs that use computer operating systems may have problems related to storage and retrieval. In addition to technological issues, AAC devices vary widely in size, weight, and cost affecting the portability and affordability of the devices (Glennen & DeCoste, 1997; Romski & Sevcik, 2005).
Current AAC methods have been effective for many people despite limitations. However, such limitations present a need for new and improved AAC methods. The Apple iPhone, iTouch, and iPad along with downloadable applications may provide a new, effective and more affordable AAC method. These products created by Apple are popular multi-media technologies that target people of all ages (Apple, 2011). The iPhone, iTouch, and iPad share in common backlit, multi-touch screens, high quality audio and visual systems, and wireless Internet capabilities that allow for applications to be downloaded. The devices are also compact and designed to be user-friendly. With newly developed and specialized applications, people with autism and other developmental disabilities may benefit from these products.

The iPad, in particular, is a wireless tablet computer (Apple, 2011). The iPad has a large touch screen that allows for easy use and precise selection. Icons shown on the iPad screen are displayed much larger than when displayed on the iPhone or iTouch. The larger screen also allows for more options to be displayed simultaneously. Despite its larger size, the iPad remains lightweight and thin. It is portable and has a battery life of up to 10 hours, allowing for all day use (Apple, 2011).

Any application produced for or by Apple can be downloaded onto an iPhone, iTouch, or iPad. Proloquo2Go is an application made by AssistiveWare that gives Apple products AAC abilities (Apple, 2011; Sennott & Bowker, 2009). The application is an AAC system that utilizes symbols, visual supports, and a text-to-speech voice output component. With Proloquo2Go, the iPad displays icons in either a grid or list view. The icons can be programmed to contain an image and a corresponding word or the word alone, thus supporting picture and/or text based communication. The icons can be selected by touching the iPad screen...
triggering the system to speak the selected message. The system has a default VocaSpace vocabulary containing over 7,000 items and is expandable via manual entries and a typing setting. The items are organized in a dynamic display making the system easy and efficient for its user. The system organizes vocabulary sets into categories, allowing the user to branch from one icon to a set of multiple icons. For example, selecting the “I want” icon will trigger the system to display a new set of options that can be selected. The iPad loads each new set of options with speed and ease (Apple, 2011; Sennott & Bowker, 2009).

The iPad and Proloquo2Go system have much in common with other AAC methods and addresses some of their limitations. The system functions similarly to PECS and may be categorized as a VOCA. Like PECS and many VOCAs, the Proloquo2Go application utilizes symbols and visual supports (Sennott & Bowker, 2009). Graphic symbols allow individuals to communicate in the absence of adequate speech and reading skills. The iPad displays images and words in multiple size options. These options allow children with poor visual or motor skills to utilize the device. The iPad’s larger screen and the sizing of icons and words place little demand on the user’s motor skill repertoire. The iPad screen and Proloquo2Go system also allow for many options to be displayed simultaneously and for easy navigation through the systems options (Apple, 2011; Sennott & Bowker, 2009). The user of the system can touch an icon to elicit a vocal response from the system. The iPad offers multiple high quality voice options for males and females. The iPad may be an improvement on other AAC devices and beneficial to ambulatory individuals with language delays due to its lightweight design, portability, and affordability (Sennott & Bowker, 2009).

Many individuals with autism and related developmental disabilities have used the iTouch, iPhone, and iPad since the release of the devices. There have
been many reports of children, adolescents, and adults benefitting from these devices and various applications such as Proloquo2Go (Harrell, 2010). Harrell (2010) highlights a family who uses various applications on the iPad with their son who has autism; the family praises the system and reports great progress for their son. This type of anecdotal evidence from families and practitioners supports the iPad AAC method; however, there is a lack of empirical support for the efficacy, advantages, and disadvantages of the devices and applications. Despite the shortage of research, this AAC method has been useful for many families and children. People with developmental delays have been taught to use the devices for various communicative purposes, including making requests (Sennott & Bowker, 2009).

Children with autism and developmental disabilities have been taught to communicate using AAC methods through naturalistic teaching interventions, discrete trial training, prompting and fading strategies, and differential reinforcement procedures (Goldstein, 2002; Mirenda, 2003; Olive et al., 2007; Schepis et al., 1998; Thomas et al., 2010; Tincani, 2004). For example, Schepis et al. (1998) used naturalistic teaching strategies in order to increase communicative interactions using VOCAs. Least to most intrusive prompting strategies were used during VOCA training as part of naturalistic instruction. Naturalistic strategies included the use of child-preferred items and the use of child responses as the point of intervention; that is, naturalistic procedures work to follow the child’s lead and motivation for items in the natural environment. In addition, the teacher conducting training sessions for the study used physical approach, expectant delay, questioning looks, and eye contact as cues to promote communicative interactions. These strategies effectively increased communicative behaviors using the VOCA
and maintained the occurrence of other effective, appropriate communicative behaviors (Schepis et al., 1998).

More structured methods of teaching have also incorporated prompting strategies, fading strategies, and the use of child preferred items as reinforcement. Structured methods of teaching often arrange training sessions into trials, rather than using the child’s response as the point of intervention. Such methods also integrate modeling, errorless learning, and differential reinforcement techniques (Thomas et al., 2010; Tincani, 2004). Thomas et al. (2010) aimed to teach children with autism or pervasive developmental delays to communicate using nonvocal mands, eye contact, oral motor approximations, and vocal mands. Prompting, fading, differential reinforcement, and prompt delay strategies successfully increased each of these categories of communicative behavior (Thomas et al., 2010).

Prompting is a key component of most communication interventions. Prompting has been systematically delayed in some interventions to promote vocal communicative behaviors. Prompt or time delay procedures involve the postponement of the prompt or model for a response; this also involves a delay in the delivery of reinforcement (Carbone et al., 2010; Charlop et al., 1985; Thomas et al., 2010; Tincani, 2004; Tincani et al., 2006). Many studies have used prompt delays to encourage spontaneous vocal responding by allowing the child time to respond prior to being prompted or reinforced. Such procedures have been successful in efforts to increase responding (Charlop et al., 1985). Tincani, Crozier, and Alazetta (2006) utilized a delay procedure with PECS training phases to encourage vocal responding. During training phase IV, a three to five second reinforcement delay was used following an appropriate PECS response. Reinforcement was delivered following the delay or contingent on a vocalization.
The delay procedure clearly demonstrated an effect on vocal responding; when the delay was present, vocal responding occurred at high rates (Tincani et al., 2006). Carbone and Sweeny-Kerwin (2010) also utilized a delay procedure with an AAC form. Vocal responding was targeted with a prompt delay and vocal prompt intervention for children who used manual sign. A five second delay occurred following an appropriate manual sign response and reinforcement was temporarily withheld. Vocal prompts of the desired vocal response were provided as a model. Additional delays took place following vocal prompts. If a vocalization occurred, reinforcement was delivered. If no response was made after three delays and vocal prompt attempts, the reinforcer was delivered. The intervention worked to increase vocal responding for all participants (Carbone et al., 2010).

The current study incorporated effective AAC teaching techniques and common delay procedures used to promote vocal responding. These strategies were used in conjunction with new AAC technology, the Apple iPad and Proloquo2Go system. Given the functional equivalence of AAC methods, the use of past, evidence-based teaching techniques for a new AAC device should be effective. Strategies were used together to effectively and efficiently train children with autism to use the iPad and Proloquo2Go system; training involved requesting for preferred items. In addition to using the AAC system, delay procedures were implemented to promote vocal responding. The study explored the iPad and Proloquo2Go system as a new technology with AAC capabilities and its potential to encourage both alternative and vocal communicative responses.

The social validity of the iPad and Proloquo2Go system were also evaluated. Social validity is the extent to which goals, procedures, or effects are liked or preferred by individuals directly or indirectly involved, as well as by members of the immediate or extended community (Schlosser, 1999; Wolf, 1978).
Applied behavior analysis’ focus on socially significant behaviors and effective outcomes calls for measures of social validity (Baer, Wolf, & Risley, 1987; Wolf, 1978). That is, it is essential to know that the goals, procedures, and effects used and found in research and applied interventions are favorable and appropriate to individuals other than scientists and practitioners. Observations and measurements may yield research or intervention data that demonstrate effective procedures and positive changes in behavior. These data coupled with social validity measurements that rely more heavily on self-reported opinions may strengthen the overall outcome of a behavior analytic study (Wolf, 1978). The social validity of the iPad and Proloquo2Go system was assessed from the perspective of each participant’s parent or guardian. Measures of social validity may enhance or diminish the utility of the iPad and Proloquo2Go system.
CHAPTER 3: METHOD

Participants and Setting
Participants were four children between the ages of 3 and 5 years old. These children were formally diagnosed with autism and were receiving therapy at a university center-based early intervention program for children with autism. Participants were assessed for their communicative abilities prior to the beginning of the study. Any potential participant who had past experience with the Proloquo2Go application was excluded from the study. In addition, any potential participants who engaged in severe problem behavior associated with access to tangibles were eliminated from the study. Parents of participants were provided with the study’s letter of purpose (Appendix A) and a consent form (Appendix B). Consent forms were signed and returned by the parents of all four participants.

Sessions took place in a therapy room familiar to the child. Preferred items in the environment were restricted and only delivered contingent on specific communicative responses. Participants were seated across from a therapist who provided any necessary prompts.

Materials
The iPad and Proloquo2Go system was used as an augmentative and alternative communication device. Proloquo2Go was downloaded onto the iPad and customized for the participants. The screen was programmed to include a field of six items, five of which were preferred items used during the study’s sessions. Preferred items were determined for each participant. Data collection forms (Appendix C), timers, and writing utensils were also utilized.
Independent Variables

The independent variable implemented following baseline consisted of an intervention used to teach children to use the iPad and Proloquo2Go system as a communication device. The intervention included the use of the iPad device, prompting, fading, differential reinforcement, and child-preferred items (Schepis, et al., 1998; Thomas et al., 2010). This independent variable was designed to train children to use the communication system in preparation for the following phase and for future use of the device. The primary independent variable was implemented following the iPad training phase to promote vocal responding. This intervention included a prompt delay and vocal prompting procedure (Carbone et al., 2010).

Dependent Variables/Response Definitions

Four dependent variables were measured throughout the study. These included immature, appropriate, iPad, and vocal communicative responses. Immature responses included reaching, grabbing, yelling, or leading (Thomas et al., 2010). Appropriate responses included pointing or manual signs. An iPad response was a communicative response using the iPad system. An iPad response was defined as the child touching an icon on the iPad screen that corresponds to an item in the environment, eliciting a voice-output. A vocal response was a vocalization corresponding to something in the environment; these responses were often approximations of target mands. Vocal target mands were defined for each participant. Frequency data were collected on each of these dependent variables during each session. Immature and appropriate responses were combined into a broader category of nonverbal behavior for the purposes of visual analysis.
**Interobserver Agreement**

The therapists conducting the sessions with participants were the primary data collectors. Additional therapists were trained to collect data on the same dependent measures. These individuals collected data simultaneously, but independently. The secondary data collector recorded data during approximately 36% of all sessions. The data collected by both individuals were compared and interobserver agreement calculated. Interobserver agreement was determined by dividing the total number of agreement by the sum of total agreements and disagreements, multiplied by 100%. Interobserver agreement was 96.32%.

**Treatment Integrity**

Implementation of the independent variable was closely observed; all components of the independent variables were clearly defined prior to implementation and monitored throughout the study (Gresham, Gansle, & Noell, 1993). A procedural checklist (Appendix D) was developed including all components of the independent variables and other crucial components of the method. This checklist was distributed to observers who checked “yes” or “no,” indicating the presence or absence of each component of the independent variable and procedure in the session. The percentage of “yes” responses was calculated for the analysis of treatment integrity. The checklist was also provided to the therapists in order to ensure proper implementation of the intervention throughout the study’s sessions. Treatment integrity measurements were recorded during 36% of sessions; treatment integrity was 96.21%.

**Design**

The study used a multiple baseline design across participants. This design demonstrated the effects of the intervention by allowing multiple participants to
experience the intervention at different points in time. This design allowed the effects of the independent variable to be shown clearly (Johnston & Pennypacker, 2009; Kazdin, 2011).

All participants began baseline phases at the same time. Following a baseline phase, an iPad training phase and prompt delay and vocal prompt phase occurred. The intervention package used to train the participants to utilize the iPad device was implemented at different times for each participant. Participants were required to reach a mastery criterion of 80% iPad responding for three consecutive sessions during the training phase. The data and the set mastery criterion determined when this training phase was complete. Following this phase, a prompt delay and vocal prompt delay phase began. This phase began at different times for each participant. Communicative responses on the iPad, immature and appropriate communicative responses, and vocal responses were recorded during the study.

Procedure

Pre-baseline Assessments

Participants were assessed for their communicative abilities prior to the beginning of the study. Assessments determined inclusion or exclusion from the study. Supervisors who worked with the children at the early intervention program were asked to complete a preliminary assessment created for the purposes of this study (Appendix E). Some questions included in this assessment were taken directly from or modified from the Functional Assessment Interview (O’Neil et al., 1997). Participants were also observed during their regular early intervention programming to determine the child’s current communication abilities.
Individuals in the study participated in preference assessments to determine highly preferred items, which may function as reinforcers during the study. A multiple-stimulus without replacement preference assessment was used to determine preferred items for each child (Carr, Nicolson, & Higbee, 2000). Approximately eight items were displayed in a linear array in front of the child. The child was asked to choose an item and was then given access to the item for approximately 10 seconds. This was repeated until all the items were chosen; the whole process was repeated twice more. The top five preferred items determined by the stimulus preference assessment were used during the trials of the session. Therapists who knew the participants were asked for a list of preferred items to inform this assessment.

**Therapist Training**

Therapists were trained to conduct sessions of the study. There were five session types corresponding to each phase and follow-up session of the study. These sessions were verbally explained to therapists in addition to a provided written procedure. Following thorough explanation, the procedure was modeled and any presented questions were answered. Feedback and corrections were provided throughout the study. Therapists were periodically tested on procedural issues to control for observer drift.

**Baseline**

A brief preference assessment occurred at the beginning of each session with the items determined by the original assessment and any novel items present in the environment. A trial began with the presentation of a preferred item for 5 seconds. If the child did not respond to the presented item within 2 to 3 seconds, a new item was presented. New items continued to be presented in a random
rotation given no communicative response from the participant. If the child engaged in an immature or appropriate communicative response, the therapist said the name of the item and gave the item to the child. Verbal responses were also accepted as a communicative response. Reinforcement periods following an appropriate response for this phase lasted for 30 seconds; if the item was edible, the reinforcement period ended when the item had been consumed. Sessions occurred approximately five times per week with a duration of approximately 20 to 30 minutes. Each session contained 20 trials with a short break between two blocks of 10 trials. The therapist was present during baseline sessions, but no prompting or direct training took place.

iPad Phase

The iPad session’s structure was similar to baseline. Items were presented in a random rotation and 20 trials were completed. However, immature and appropriate nonverbal responses were not accepted and did not result in the delivery of a preferred item during this phase. Instead, these attempted responses were recorded, but redirected; a communicative response on the iPad and Proloquo2Go system was prompted. Least to most prompting strategies, fading techniques, and differential reinforcement procedures were used to train participants to use the device (Thomas et al., 2010). A therapist continued to be present during iPad sessions. The therapist was responsible for presenting preferred items, for delivering reinforcement, and for prompting the child to respond with the iPad when necessary. Verbal and iPad responses only were accepted and reinforced during this phase. When the child engaged in independent iPad responses for 80% of trials during a session for three consecutive sessions, the participant advanced to the next phase of the study.
**Prompt Delay/Vocal Prompt Phase**

The structure of sessions remained the same during the vocal responding phase; the iPad was still in use, but a prompt delay procedure began (Carbone et al., 2010). Following a response on the iPad, a 5-second delay occurred. If the child responded with a vocal approximation or word during the delay, the preferred item was delivered for a 30-second reinforcement period or until the item had been consumed. If no response occurred following the iPad response, a vocal prompt occurred. A vocal response within 5 seconds of this prompt resulted in delivery of the preferred item. If no vocal response occurred, a new item was presented. Following five no response trials, an additional vocal prompt was added to the following trials until the block of 10 trials was completed; however, this only occurred during one session for one participant. If there was no iPad or vocal response following the presentation of an item, the child was prompted to respond with the iPad and the trial was completed according to the aforementioned procedure. Preferred items were delivered following any verbal response.

Responses on the iPad followed by delays and prompts, but no vocal response resulted in a delayed delivery of the preferred items; the child was given the item for 10 seconds or a smaller edible item for this response. Two blocks of 10 trials occurred during each session. This phase was complete when the participants engaged in at least 80% vocal responding across three consecutive sessions.

**Follow-Up Session 1 – Choice Probe**

Following the completion of the prompt delay and vocal prompt phase, participants participated in a brief choice session. This took place in the same setting with a therapist. Similar to other phases, the child did not have access to the preferred items in the room. Access was only granted if the child made an initiation to the therapist for an item. However, the therapist did not randomly
present various items. The therapist had a clear box full of the child’s preferred items. The iPad was sitting out of the child’s reach; the therapist did not hold the iPad or place the device in the child’s lap. The child was able to choose the method of communication to request for a preferred item. This session lasted for 10 minutes. The occurrence of the four dependent responses was recorded.

**Follow-Up Session 2 – Vocal Probe**

Following the completion of the choice probe, participants participated in a session targeting vocal responses. The session’s structure was identical to baseline sessions. Preferred items from a preference assessment were presented in a random rotation and no iPad was present; a total of 20 trials were completed. During this session, only vocal responses were accepted and were followed by the delivery of a preferred item.

**Social Validity**

Parents of participants were asked to complete a social validity questionnaire prior to the beginning and following the completion of the study. The pre and post questionnaire (Appendix F) focused on the acceptability of the procedures and the acceptability of the iPad and Proloquo2Go system; only items 1-10 were measured pre and post completion of the study, whereas items 11-19 were measured only following the completion of the study. The questionnaire was developed based on previous questionnaires used for AAC related studies. Some statements were modified from the Communication Aid/Device Attitudinal Questionnaire (Lilienfeld & Alant, 2002).
CHAPTER 4: DATA ANALYSES & RESULTS

Collected data were graphed and evaluated using visual analysis throughout the study. Phase changes were based on the data collected and predetermined criteria. All four participants were able to learn one-word requests on the iPad and Proloquo2Go system. Vocalizations for all four participants increased in conjunction with iPad responses.

Adam

Results for Adam are displayed in Figures 1 and 2. In baseline, nonverbal responding was high, whereas verbal responding was low. There was an average of 17.75 nonverbal responses and an average of 1.5 verbal responses out of a possible of 20 across four baseline sessions. Adam’s nonverbal behavior consisted mostly of appropriate responding. Adam’s verbal responding consisted of approximations of words. During the iPad phase, nonverbal responding decreased significantly. Responding on the iPad was high throughout the entire iPad phase; Adam responded on the iPad an average of 17.75 trials out of a possible 20 across four iPad sessions. Adam reached the mastery criterion in three sessions, but remained in the phase for one more sessions due to a potential uptrend in his verbal responses. Adam verbally responded during an average of 0.75 trials out of a possible 20 during this phase. During the prompt delay and vocal prompt phase, nonverbal responding occurred at near zero levels. Responding on the iPad maintained during this phase; Adam responded on the iPad during an average of 19.15 out of 20 trials. Verbal responding increased during this phase. Adam responded verbally an average of 14.73 out of 20 trials. Adam reached the mastery criterion of 80% verbal responding across three consecutive sessions after completing 26 sessions in the prompt delay and vocal prompt phase. There were
no overlapping vocal data when comparing both baseline and iPad phases to the final phase.

Vocal responses could occur before an iPad response, after an iPad response during the prompt delay, or after the vocal prompt during the final phase of the study. Figure 2 displays this categorization of vocal responses for Adam. Overall, Adam vocally responded most frequently during the prompt delay; this increased overtime, whereas vocal responses after the vocal prompt decreased over time. An increase in vocal responses after the vocal prompt occurred following a week-break for Adam; however, this eventually decreased and returned to low levels. Adam responded vocally without the use of the iPad occasionally, a total of 15 times in 26 sessions.

During the choice probe follow-up session, Adam responded once nonverbally, six times using the iPad, and six times vocally. During the vocal probe follow-up session, Adam responded 16 times vocally out of a possible 20 opportunities.

**Ben**

Results for Ben are displayed in Figures 1 and 3. During baseline, there was an average of 14.29 nonverbal responses per session out of a possible 20 trials; nonverbal responding increased throughout the phase. Ben averaged 1.14 verbal responses per session. Ben nonverbal responses were both immature and appropriate; there were slightly more immature nonverbal responses. Verbal responses were all approximations of words. Ben participated in seven baseline sessions. During the iPad phase, nonverbal responding decreased significantly. Responding on the iPad increased throughout the phase; Ben reached the mastery criterion after completing eight iPad sessions. Ben’s verbal responding remained
at low levels. There was an average of 0.25 verbal responses per session during the iPad phase. In the prompt delay and vocal prompt phase, nonverbal responding occurred at zero levels. Responding on the iPad maintained; Ben responded an average of 18.17 out of 20 trials per session. Verbal responding increased from the previous phases to an average of 12.59 verbal responses per session. Ben met the verbal responding mastery criterion and exited the phase after the 29th prompt delay and vocal prompt phase session. There were no overlapping vocal response data when comparing both baseline and iPad phases to the final phase.

Figure 3 displays the categorization of vocal responses for Ben. At the beginning of the prompt delay and vocal prompt phase, Ben vocally responded more frequently following the vocal prompt and less frequently during the prompt delay. As demonstrated in the figure, vocal responding shifted over time. Ben finished the phase consistently responding more often during the prompt delay. Ben responded vocally twice without the use of the iPad in 29 sessions.

During the choice probe follow-up session, Ben responded three times nonverbally and nine times using the iPad; he did not respond vocally. During the vocal probe follow-up session, Ben responded nine times vocally.

Chris

Results for Chris are displayed in Figures 1 and 4. During baseline, nonverbal responding was high and verbal responding was low. There was an average of 14.33 nonverbal responses and an average of 1.67 verbal responses out of a possible of 20 across twelve baseline sessions. Chris’s nonverbal behavior consisted mostly of immature responding. Chris’s verbal responding consisted of full words. In the iPad phase, nonverbal responding decreased to an average of
0.77 responses per session. Responding on the iPad increased throughout the session. Chris reached the mastery criterion after completing 22 sessions. Verbal responding remained low during this phase; verbal responding only occurred an average of 0.14 times per session. During the vocal phase, nonverbal responding occurred at near zero levels. Responding on the iPad maintained from the previous session; iPad responses occurred an average of 18.33 times per session. Verbal responding increased during this phase; there was an average of 19 verbal responses per session. Chris met the verbal responding mastery criterion in only three prompt delay and vocal prompt phase sessions. There were no overlapping vocal data when comparing both baseline and iPad phases to the final phase.

Figure 4 displays the categorization of vocal responses for Chris. During Chris’s first and second prompt delay and vocal prompt session, Chris vocally responded more frequently following the vocal prompt and less frequently during the prompt delay. During the third and final session of the phase, vocal responding shifted; more vocal responses occurred during the prompt delay and fewer responses occurred following the vocal prompt. Chris did not respond vocally without the use of the iPad in three sessions.

During the choice probe follow-up session, Chris responded 8 times nonverbally, 3 times using the iPad, and 11 times vocally. During the vocal probe follow-up session, Chris responded twice vocally.

**David**

Results for David are displayed in Figures 1 and 5. In baseline, there was an average of 16.17 nonverbal responses per session out of a possible 20 trails. David verbal responding ranged from zero to nine verbal responses per session; there was an average of 2.26 verbal responses per session. David participated in a
total of 23 baseline sessions. The majority of David’s nonverbal responses were immature responses; David’s verbal responses consisted of approximations of words and full words. During the iPad phase, nonverbal responding decreased to an average of one nonverbal response per session. David reached the iPad mastery criterion of 80% or above across three consecutive sessions in 12 sessions. Verbal responding during this phase remained at low levels; David verbally responded an average of 1.17 times per session out of a possible 20 opportunities. During the prompt delay and vocal prompt phase, nonverbal responding occurred at zero levels. David responded using the iPad an average of 17 times per session. David’s verbal responses increased from the previous sessions and occurred an average of 17.50 times per session. David met the mastery criterion in three prompt delay and vocal prompt sessions, but a fourth session was conducted due to a slight downturn in iPad responding. During the final session, both iPad and verbal responding occurred above mastery levels. There were no overlapping vocal data when comparing both baseline and iPad phases to the final phase.

Figure 5 displays the categorization of vocal responses for David. During all four sessions of the prompt delay and vocal prompt phase, David vocally responded more frequently during the prompt delay and less frequently following the vocal prompt. David responded once vocally without the use of the iPad in four sessions.

During the choice probe follow-up session, David did not respond nonverbally or vocally. David responded 11 times using the iPad. During the vocal probe follow-up session, David responded 10 times vocally.
Figure 1. Frequency of communicative behaviors per session for all participants and phases
Figure 2. Frequency of three categorizations of vocal responses. The solid line is the trend line for vocalizations during the prompt delay. The dashed line is the trend line for vocalizations following one vocal prompt.

Figure 3. Frequency of three categorizations of vocal responses. The solid line is the trend line for vocalizations during the prompt delay. The dashed line is the trend line for vocalizations following one vocal prompt.
Figure 4. Frequency of three categorizations of vocal responses

Figure 5. Frequency of three categorizations of vocal responses
Social Validity

Social validity results are displayed in Figures 6 and 7. Parents of participants returned 100% of pre-study questionnaires; only 75% of post-study questionnaires were returned. Social validity ratings reported by the parents do not indicate a difference when rating the same questionnaire statements pre and post-study (Appendix F – Items 1-10). A rating of 5 indicated agreement with the questionnaire statement and a rating of 1 indicated disagreement. An average rating of 4.70 was reported pre-study; an average of 4.34 was reported post-study. Overall, ratings on Items 1-10 were high. Additional items included on the post-study questionnaire were also high. Averaged ratings of all 19 items on the questionnaire ranged from 3.68 to 4.79. High ratings suggest social validity in relation to the questionnaire’s statements regarding the study’s procedures and device used.

Figure 6. Averaged pre and post-study social validity ratings on Items 1-10
Figure 7. Individual participant social validity ratings on Items 1-19
CHAPTER 5: DISCUSSION

Prompt delay and vocal prompting procedures are often used in conjunction with vocal training procedures and augmentative and alternative communication systems (AAC). Past research has supported the effectiveness of such procedures with systems, such as sign language training and picture exchange communication training (Carbone et al., 2010; Tincani et al., 2006). Results of the present study indicated that prompt delay and vocal prompting procedures could be used effectively in conjunction with the iPad and Proloquo2Go communication system in order to promote vocal responding. In addition to this, the study revealed that basic behavioral teaching techniques, such as prompting, fading, and differential reinforcement, could be sufficient in training children with autism to use the iPad and Proloquo2Go system to produce single-word requests. This result is consistent with anecdotal evidence and preliminary observations of communicative responding on the iPad device.

During baseline, all participants engaged in a high frequency of nonverbal responses and a low frequency of vocal responses. For Adam and Ben, there was an increasing nonverbal responding trend during baseline, whereas for Chris and David there was a steady state of nonverbal responding. Adam and Ben were the first two participants to begin the intervention phases of the study. Due to the structure of the multiple baseline design, Adam and Ben had fewer sessions in baseline then Chris and David. It is expected that a steady state of responding would have emerged given more baseline sessions for these two participants. There was also an increasing trend in David’s initial sessions, which eventually stabilized. However, the child’s preferences and the reinforcer effectiveness of the items used in the study may also explain these data. Throughout the study,
participants chose items during the preference assessments, which took place at the beginning of the experimental session. Items from the child’s daily environment and novel items were utilized. The novelty of some items used may have contributed to the increasing trend during baseline for Adam and Ben. The increase could be a reinforcer sampling effect; the reinforcing effectiveness of the preferred items may not have been fully established at the beginning of baseline. The increase could more simply be the result of positively reinforcing the nonverbal response with the preferred item, resulting in an increase in the nonverbal response.

Following the introduction of the iPad and Proloquo2Go device, nonverbal responding decreased significantly for all participants. This occurred regardless of the topography of the child’s nonverbal behavior. The defined iPad response functionally replaced the previously used inappropriate and appropriate nonverbal responses. There were varying rates of acquisition for the iPad response. These rates of acquisition were a function of the individual participants’ differences. However, other variables may have contributed to this phenomenon. During baseline, Adam engaged in both immature and appropriate responding. However, most of Adam’s nonverbal responses were appropriate nonverbal responses in the form of a pointed hand. Adam acquired the iPad response most efficiently in comparison to the other participants. This may be due to the similar topography of the majority of his nonverbal responses and the iPad response or due to previous establishment of a nonverbal functional mand. Children who already reliably use a point response to communicate and who, therefore, engage in nonverbal functional manding behaviors may more efficiently learn to utilize a touch screen device, such as the iPad.
Ben, Chris, and David also acquired the iPad response. These participants all utilized immature and appropriate responses, but utilized immature responses more frequently. Ben responded quickly to the teaching procedures used during the iPad phase. Responses on the iPad occurred at a low frequency during the first session and gradually increased to criterion. Chris began the iPad phase and was then absent from the study due to illness. This illness occurred prior to a 1-week break that occurred for all participants. Upon Chris’s return, iPad responses were occurring at low levels and remained at low levels for many sessions. At the beginning of Chris’s thirtieth session, novel items were incorporated into a more thorough preference assessment. During this session, Chris responded on the iPad more frequently and, based on observation, was attending to the preferred items and iPad screen more effectively. The novel items were incorporated into future sessions and Chris’s iPad responding increased. The delay in Chris’s acquisition of this skill may be due to the use of ineffective reinforcers utilized as suggested; however, this also may be partially due to Chris’s absence from the study and from his regular behavior therapy for two weeks. David also was slightly delayed in his acquisition of the iPad response. This delay was most probably due to the interference of a low-intensity problem behavior, in relation to the reinforcing value of the iPad device. During David’s initial iPad sessions, David would attempt to grab the iPad or press the home button on the device. If successful in pressing the home button, David would use his finger to scroll through pages on the iPad. Therapists working with David blocked his attempts to grab or push buttons of the system. Blocking often resulted in emotional behaviors, such as crying and throwing his body forward. Blocking these behaviors while also prompting the study’s responses resulted in a decrease in the problem behaviors, which were eventually extinguished. David’s previous experience with Apple
products, as indicated by assessments that occurred prior to baseline, is likely to have resulted in these behaviors. The initial presence of the iPad resulted in an extreme decrease in the reinforcing value of the preferred items used in the sessions. As the problem behaviors associated with the iPad decreased, David again showed interest in these items and began responding using the iPad in order to gain access; the reinforcing value of the session’s preferred items was reestablished in the iPad’s presence.

The iPad and Proloquo2Go system was a functional AAC device for the specific purposes of the current study’s protocol and target behaviors. Participants were able to effectively and appropriately request preferred items presented in the environment. The participants’ iPad response functioned as verbal behavior and controlled the behavior of the listener. The iPad and Proloquo2Go system, like many other augmentative and alternative systems, allowed for a level of clarity and specificity in communication that many nonverbal responses do not allow. The likelihood that the communicative behavior of the child would effectively control the behavior of the listener may be increased by the use of the iPad and Proloquo2Go system. This point is especially important when working with children who use approximations to communicate which may be unintelligible. If the speech or vocal responses of a child are failing to activate the environment, an AAC system may allow for the child’s communication skills to become more functional and for the more effective and immediate shaping of vocal responses.

Upon implementation of the prompt delay and vocal prompt procedure, an increase in vocal responding occurred for all participants; iPad responding maintained and nonverbal responding remained at low levels. All participants met the vocal responding criteria during the final phase of the study; however, there were individual differences in the amount of time needed to reach high levels of
vocal responding. Adam and Ben met criteria in 26 and 30 sessions, respectively, whereas Chris and David only required the minimum number of sessions to meet criteria. This difference may be due to the participants preexisting vocal abilities. Assessments conducted prior to the beginning of the study indicated that all participants possessed some vocal abilities; however, Adam and Ben’s repertoires mostly consisted of vocal approximations, whereas Chris and David’s repertoires consisted of both approximations and complete words. These preexisting skill levels may explain the more rapid increase in vocal responding for these two participants. Vocal responding may also have been more effortful for Adam and Ben given their limited vocal abilities.

In addition to this, Adam and Ben were the only participants for whom the 1-week break occurred during the prompt delay and vocal prompt phase of the study. This break may have delayed the eventual increase in Adam and Ben’s vocal responding. Primary measures do not indicate changes in the frequency of vocal responding after the break. However, when analyzing these data in respect to whether the vocalization occurred during the initial prompt delay or following the vocal prompt, it is indicated that changes did occur for at least one of these participants after the 1-week break. That is, more vocal prompts were delivered to Adam following the 1-week break due to no responding during the prompt delay (Figure 2). The delivery of vocal prompts decreased over time following this break.

The prompt delay and vocal prompt were effective in changing behavior for all participants. There was an immediate increase in vocal responding upon implementation of the combined intervention. It is important to note that this change in vocal responding was robust for all participants. No overlapping vocal responding data points were recorded upon implementation of the prompt delay
and vocal prompt intervention and throughout the entire final phase. That is, vocal responding did not gradually increase from previously low baseline and iPad phase levels. Instead, vocal responding increased significantly at the point of intervention and following.

The combined effectiveness of the prompt delay and vocal prompt procedures was indicated by the analysis of the vocalization’s presence during the prompt delay or following the vocal prompt. These vocalization categorizations are displayed in Figures 2-5 (pp. 34-35). Adam vocalized most frequently during the prompt delay with the exception of only two sessions, one of which was following the 1-week break. Ben vocalized most frequently following the vocal prompt during the initial sessions of this phase. However, vocalizations following the prompt decreased; vocalization during the prompt delay increased throughout the phase. David responded during the delay almost exclusively across four sessions. Chris responded most frequently following the prompt and less frequently during the delay during the first two sessions of this phase; this reversed in the third and final session of the phase. These data also indicated that Adam, Ben, and David vocalized without the occurrence of an iPad response on some occasions. This occurred infrequently for all three participants. However, it suggests the possibility of fading or eliminating the use of AAC systems. These vocal responses without a previous iPad response emerged without being targeted directly. The second follow-up session, during which the iPad was removed, demonstrated that vocalizations could occur without the use of the iPad device. Participants engaged in between 2 and 16 vocalizations out of a possible 20 opportunities during the second follow-up session.
Limitations

The current study has several limitations in relation to its participants and setting. All participants were enrolled in a university center-based early intervention program for children with autism. This program was highly individualized and targeted a variety of skills, including communication skills. Participants had a history with pivotal response training (PRT) protocols, which may have interfered with the current studies results. PRT is a naturalistic training procedure that is often used to promote vocal responding; the procedure involves prompt delays and vocal prompts. The participants experience with such protocols may have influenced the effect of the intervention.

In addition, the program facility that the participants attended was closed for a 1-week break during the study. Parents were contacted in an attempt to continue the study during this break. However, some parents were unable to attend during this time. The 1-week break may have affected the outcomes of the study as previously mentioned. More rapid acquisition may have occurred if the study had run continuously. The structure of the participants’ program facility and changes at the facility during the study were also limitations. Sessions most often took place in the child’s designated therapy room. These rooms were structured to accommodate multiple clients while maintaining an adequate learning environment. Scheduling changes at the facility caused temporary overcrowding in some therapy rooms. Because of this, some participants were taken out of their designated room to participate in the study’s sessions. These environmental changes, which occurred for some but not all sessions, may have impacted the study’s outcomes. However, these changes were made to ensure proper control over the experimental session. Finally, participants’ behavior was not measured outside of the experimental session; it is impossible to know if the study’s protocol
had a broader impact on the child’s behavior. However, Ben’s parents did provide some unsolicited feedback regarding an increase in vocal mand attempts in the home setting.

Potential limitations in relation to the study’s methodology also exist. The implementation of the prompt delay and vocal prompt together as a package intervention were effective in changing behavior. However, the effects of the prompt delay independent of the vocal prompt are unknown. The majority of vocalizations that occurred across participants occurred during the prompt delay, rather than after the vocal prompt. A future component analysis may target the prompt delay in the absence of other interventions.

The preference assessments utilized throughout the study may be another limitation. Participants were able to choose preferred items in preference assessments that were conducted at the beginning of each session. This was done to ensure the quality and effectiveness of the items, which were to be used as reinforcers during the session. However, variability in the child’s preferences may have produced variability in the child’s ability to vocally respond to gain access to a particular item. For example, Adam often chose a toy car as one of the items in the rotation of preferred items. However, Adam failed to approximate the word during the study. If car was chosen and was included in the rotation, it was presented a total of four times. This created a ceiling effect during sessions in which the car was present. That is, Adam could engage in a vocal response only 80% of the time. This prolonged Adam’s participation in the prompt delay and vocal prompt phase and suggests that some variability seen in Adam and Ben’s data may be attributable to variability in the child’s preferences. Despite this issue, it was essential to begin a session with a preference assessment. Overall,
there was minimal variability in the child’s preferences, which suggests that there was a minimal effect on vocal responding data.

Finally, the current study is unable to suggest the function of the voice-output of the iPad and Proloquo2Go system and its potential effects on vocal behavior. It is unclear if the voice-output could have acquired the function of a discriminative stimulus or prompt. It is uncertain if the child is making behavioral contact with the auditory stimulus or if the voice-output has the potential to change behavior. It is possible that the child fails to attend to the auditory stimulus. This may suggest that the point and touch aspect of the iPad response is the communicative response, even in the absence of the voice-output. If the child is attending to the voice-output, it may simply function as immediate feedback, rather than a potential discriminative stimulus. This point is especially important when considering Chris. Chris has a history of engaging in echolalic behaviors. During the prompt delay and vocal prompt phase of the study, Chris vocally responded during the prompt delay and following the vocal prompt. In his final session, Chris responded more often during the prompt delay. This suggests that his vocal responses were not echolalic responses. However, if the voice-output has the potential to function as a prompt, it is possible that the vocalization that occurred during the prompt delay were echoes of the voice-output. Follow-up sessions during which Chris responded vocally without the prior use of the iPad suggest that responses throughout the study were not echolalic vocalizations; Chris utilized a variety of responses during the follow-up choice probe and responded 11 times vocally. However, Chris’s vocal responding during the follow-up vocal probe session without the iPad occurred at baseline levels. It is not currently possible to address this issue fully.
The current study revealed some limitations of the iPad and Proloquo2Go system. Some of these limitations are suggested by the iPad and Proloquo2Go’s system capabilities, the study’s data, and observations of the study’s sessions. The iPad is a commercial device that serves a variety of functions, which are expanded even further with access to the Internet and downloadable applications. It is only with the addition of an application that the iPad can function as an AAC device. The iPad’s purpose is primarily commercial, not clinical. Because of this, the device fails to provide some features that would improve it for communicative purposes. For example, the iPad currently lacks the function to adjust touch screen sensitivity. Many users need to be able to adjust this sensitivity in order for the iPad to be functional as an AAC system. This feature is included on many other voice-output AAC devices.

In addition to this, the iPad’s operating system and applications are constantly evolving through program changes and updates. The iPad’s features and settings may change; however, it is unknown if these changes will benefit the community of individuals using the device for communication. The device’s primary use is not AAC so this cannot be assumed. Changes on Proloquo2Go also occur periodically. These changes include changes to the application’s settings, addition of new settings, and visual changes to functional icons. For example, a recent update added the appearance of back and forward icons with arrows at the bottom of each page on the application. It may be challenging for care providers, clinicians, and users of the system to adapt to such changes. This is especially true for some children with autism who engage in rigid or fixed behavior patterns. Minor changes have the potential to cause various complications for children with autism learning to use the device.
As previously mentioned the iPad device serves multiple functions; this too may be a limitation when attempting to use the device as a communicative tool. Some functions may be problematic or directly interfere with communication behaviors. It is possible that the iPad and Proloquo2Go system may acquire a reinforcing function. This is especially likely if the user has previous experience with Apple technologies, but is also possible with no previous experience. If a child has experience with the iPad and its applications, such as games or videos, the iPad may already function as a reinforcer. Using the system as a communication device following this experience may directly interfere with learning. For example, when beginning the iPad phase, David responded to the system as if it was a preferred item; that is, David would reject typically preferred items in favor of making attempts to access the iPad system. This behavior was eventually extinguished; however, the reinforcing qualities of the system did delay acquisition. In addition, when given free access to the communication device during follow-up session one, David did return to previous behaviors, such as hitting the home button, scrolling, and touching applications other than Proloquo2Go. David cried when the iPad was removed at the end of the session. Even if a child has no experience with the system, the interactive nature of the touch screen and the appearance of other applications may be reinforcing for some individuals, which could interfere with learning and communication. This is true even on a system without downloaded applications. With downloaded applications, such as education or game applications, the system will likely become reinforcing.

An AAC system that functions as a reinforcer may work to decrease the frequency of communicative attempts made by the user of the system. This idea parallels issues related to empirically validated reinforcement strategies, such as
the token economy. A token economy must utilize conditioned reinforcers in the form of tokens. These tokens cannot be high value reinforcers; the tokens cannot be greater in value than some back-up reinforcer that the individual is earning by gaining access to tokens first. If the token itself is a valuable reinforcer, the individual may not respond at high levels over time or may not wish to make an exchange for a back-up reinforcer. This is similar to the problems with the iPad device. If the child has access to their communication device at all times in order to maximize effective communication and minimize associated problem behavior, the child may also have access to a valuable reinforcer. The child may not engage in a communicative response to gain access to other items if the child is already in possession of a reinforcer with multiple functions. It may be even more difficult to train children to engage in self-help related communicative behavior, like requesting to use the bathroom, if access to the device is highly reinforcing. It may be necessary to systematically train children to stop using one application in order to return to the communication related application or to discriminate between play and work activities. Some individuals have targeted these issues by purchasing a reinforcer iPad and a communication iPad. However, this is problematic both in relation to cost and portability.

Given the potential of the iPad to function as a reinforcer, it may be difficult to determine the child’s preference for the communication system in comparison with other systems. Past studies have included additional components or follow up sessions to determine a child’s preference for communications systems, such as picture exchange or voice-output communication systems. Communication system preference would be impossible to determine if the iPad has other downloaded application on the system. The reinforcing nature of these
applications and the system would interfere with a preference assessment targeting the communication system types.

**Future Research**

Future researchers should continue to target prompt delays, vocal prompts, and AAC strategies. It may be appropriate to conduct a component analysis in order to isolate the effects of the prompt delay in the absence of the vocal prompt. This analysis may enhance the overall understanding of the prompt delay procedure and may inform future research and the development of more efficient and effective applied procedures. It is important to target these procedures in relation to current vocal training procedures and a wider variety of AAC systems. Future research may also incorporate the systematic shaping of vocalizations into these procedures.

A plethora of research targeting the iPad as a communication device must be conducted, in addition to research on communication applications, such as Proloqou2Go. Currently, few studies exist on these issues. However, many children and adults are using the iPad as a communication system. Researchers must answer meaningful questions regarding the efficacy and functionality of the iPad system in order to inform applied interventions. It is essential to determine through research the prerequisite skills necessary to utilize the iPad device and various applications and how to overcome the potential reinforcing value of the iPad system.

Researchers may wish to target effective teaching strategies and prompting procedures. The current study suggests that simple behavioral strategies and basic prompting procedures are effective; however, more evaluation of teaching strategies is needed, especially in relation to more complex communication forms.
The current study only required participants to engage in one-word mands; future studies should target other verbal operants and sentence structure. Such research may utilize the stages of PECS and other AAC research to inform target behaviors and necessary components of AAC development. Research may also examine the necessity of the communicative exchange as used in a picture exchange procedure versus a point and touch iPad communicative response.

Future research may also evaluate the use of an iPad and Proloquo2Go specific prompt. The current study utilized a prompt in which the therapist would touch and hold a particular icon on the Proloquo2Go screen. Upon contact with the icon, the icon would shrink and change slightly in color. This served as a more intrusive prompt than a visual pointing prompt and a less intrusive than a physical prompt. The effects of the voice-output, as previously mentioned, should also be a target of future research; this may be done by systematically replicating the current study with the volume on the iPad turned off. In addition to this, questions remain regarding the iPad’s effect on vocal responding. The current study demonstrated that iPad responding and vocal responding can occur jointly. Future research should explore any potential interference of these two types of responding.

Future researchers should also target the use of the iPad device across populations, diagnoses, ages, and settings. The current study targeted a specific population and age group in the same setting. It is essential to study other environmental variables in relation to the iPad communication system. For example, interventions for adults with acquired or temporary language disorders may benefit from the system and avoid limitations common for children. The functionality of the device in the classroom is another necessary investigation. The social validity of the system and related interventions should also be incorporated. A commercial device that is common in society may be more
socially valid for some individuals, in comparison with other systems. This may be especially true for an adult with an acquired or temporary language disorder or for a high functioning, nonverbal individual with autism or other diagnoses. However, the device may not be socially valid from the perspective of the teacher or other students in a classroom. Finally, a cost and benefit analysis should be conducted based on future research and in relation to various populations, diagnoses, ages, and settings.
CHAPTER 6: CONCLUSION

The iPad and Proloquo2Go system may provide a functional and socially acceptable communication method for children with autism and for other individuals with communication disorders. The device and its technologically advanced features may be desirable for some individuals, especially those individuals who have been limited in some way by other AAC methods. The current study suggests the system’s possible utility in promoting vocal communication skills when combined with behavioral interventions, such as the prompt delay and vocal prompt.

The current study continues the research previously conducted on prompt delays, vocal prompts, and AAC strategies. This study is most closely related to the methodology and research questions of a study conducted by Carbone et al. in 2010. The results of Carbone et al. (2010) are supported by the results of the current study. The prompt delay and vocal prompt can be effective in conjunction with AAC strategies. This study extends these finding by utilizing the prompt delay and vocal prompt intervention with the iPad and Proloquo2Go system. The current study demonstrated these effects in fewer trials and with a different AAC system. This demonstrates the power and versatility of this type of intervention.

Future research must address the AAC potential of the iPad device, as well as the potential limitations highlighted by the current study. The iPad device may be a useful tool for some individuals. However, other individuals may not benefit due to limitations of the device or applications and problem behaviors. Further exploration of AAC systems, strategies, and interventions will surely impact the field of applied behavior analysis, special education, speech language pathology,
and related fields, as well as the individuals targeted by communication interventions.
REFERENCES
REFERENCES


APPENDICES
APPENDIX A: LETTER OF PURPOSE
The purpose of this study is to investigate the effects of the iPad on requesting behavior and vocal responding in children with autism. The researcher hopes that by conducting this study, the participants involved will have an increase in requests for preferred items using the device and/or vocally.

All research that is conducted will take place in the Central California Autism Center and Joyce L. Huggins Early Education Center located on the California State University, Fresno campus. All information will be kept confidential in a locked cabinet in a secure office on the grounds of Fresno State.

Training sessions will take place in one of the therapy rooms at the CCAC where the children work everyday. Training sessions will last approximately 15 minutes with some of the time spent playing with preferred items. Data will be collected on requesting behaviors throughout each session.

This study will be conducted under the watchful supervision of Dr. Amanda Adams. Dr. Adams is a professor at California State University, Fresno, a Board Certified Behavior Analyst, and is the Director of the Central California Autism Center located on the Fresno State campus.

If you have any questions about this study and would like to participate, please contact Gina Gavrilis.

Thank you.
APPENDIX B: PARENT INFORMED CONSENT FORM
Your child is invited to participate in a study conducted under the auspices of the Central California Autism Center, in the Department of Psychology, at California State University, Fresno. The principal researcher is Dr. Amanda Adams. The study is entitled “Evaluating iPad Technology as an Augmentative and Alternative Communication Device and its Effects on Vocal Communication Skills.” If you decide to participate in this study, please carefully read the information provided below prior to signing this consent form. This document describes the study and your rights as a participant in this research.

1. Description of Research: This study is designed to evaluate the effects of the iPad on communication. Your child will be taught to use the iPad in order to request preferred items during teaching sessions. In addition, your child will be prompted to vocalize the requests made on the iPad. Your child will participate in 15-minute sessions Monday thru Friday for approximately 6 weeks. You may withdraw your child from the research without penalty at any time. This form can be translated into multiple languages according to the needs of the parents.

2. Risks and Discomforts to Research Participants: No discomforts or hazards associated with this research have been identified. There is a possible risk of tantrums or other aberrant behaviors. However, we do not expect these behaviors to be out of the ordinary daily routine of any participant or family.

3. Benefits to Research Participants: We cannot guarantee that research participants will receive any benefits from participating in this study, but everyone who helps with this work will be contributing directly to our knowledge of best treatment for children with autism. In addition, participants will be encouraged to use vocal language, which is a part of the child regular programming intervention.

4. Alternate Procedures: No diseases or dysfunctions will be treated, so alternate procedures are not applicable.

5. Confidentiality of Research Data: Absolute confidentiality of data and records will be maintained. Names will not be maintained with data protocols, and informed consent forms will be kept separate from data. All raw data and forms will be kept under locked secure conditions, and destroyed five years after collection.
6. Information Resources Available to Research Subjects:

- Questions Regarding the Rights of Research Subjects: The CSUF Committee on the Protection of Human Subjects, (559) 278-4468
- Questions Regarding the Nature of the Research: Dr. Amanda Adams, (559) 278-2479
- Questions Regarding Research-Related Injuries: There should be no danger of such injuries, but any such enquiries should be directed to Dr. Amanda Adams or to the Committee on the Protection of Human Subjects.

7. Over the course of this study three to five volunteers are expected to participate.

8. Your child’s participation in this project is completely voluntary. Your decision whether or not to participate will not prejudice your future relations with CSU, Fresno, the Central California Autism Center, or the Joyce L. Huggins Educational Center. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without penalty. The Human Research Committee of the CSUF Department of Psychology, and the Human Research Committee of CSUF, has reviewed and approved the procedures for the present research.

9. You may have a copy of this form to keep.

YOUR ARE MAKING A DECISION WHETHER OR NOT TO PARTICIPATE. YOUR SIGNATURE INDICATES THAT YOU HAVE DECIDED TO PARTICIPATE, HAVING READ THE INFORMATION PROVIDED ABOVE.

__________________________________________
Date Parent’s Signature Parent’s Name (Please Print)

__________________________________________
Student’s Name (Please Print) Project Director’s Signature

Dr. Amanda Adams
APPENDIX C: DATA COLLECTION FORMS
Date:          Participant:          Therapist:  

IOA?          Data Collector: 

<table>
<thead>
<tr>
<th>Preference Assessment</th>
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</thead>
<tbody>
<tr>
<td>1</td>
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<tr>
<th>Break</th>
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<tbody>
<tr>
<td>1</td>
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</tbody>
</table>

Inappropriate – I
Appropriate – A
iPad – i
Vocal – V
Prompt – P
No response – ·
Correct – /
<table>
<thead>
<tr>
<th>Preference Assessment</th>
</tr>
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<tbody>
<tr>
<td>1</td>
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<tr>
<td>Verbal Prompt</td>
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<td>2</td>
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<td>Verbal Prompt</td>
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<td>3</td>
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<td>Verbal Prompt</td>
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<td>Verbal Prompt</td>
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<td>Verbal Prompt</td>
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Break

| 1                     |
| Verbal Prompt         |
| 2                     |
| Verbal Prompt         |
| 3                     |
| Verbal Prompt         |
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| Verbal Prompt         |
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| 10                    |
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| Verbal Prompt         |
APPENDIX D: TREATMENT INTEGRITY CHECKLIST
### TREATMENT INTEGRITY CHECKLIST

<table>
<thead>
<tr>
<th>Intervention Task</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Conduct preference assessment</td>
<td></td>
</tr>
<tr>
<td>2. Use child preferred items as shown by assessment</td>
<td></td>
</tr>
<tr>
<td>3. Use least to most prompting strategies</td>
<td></td>
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<tr>
<td>4. Deliver reinforcement contingent on dependent response</td>
<td></td>
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<tr>
<td>5. Deliver accurate amount of reinforcement (duration/edible)</td>
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<tr>
<td>6. Use iPad and Proloquo2Go system</td>
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<tr>
<td>7. Use prompt delay</td>
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<td>8. Prompt delay lasts 5 seconds</td>
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<td>9. Use vocal prompts</td>
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<td>10. Provide correct number of vocal prompts</td>
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<tr>
<td>11. 20 trials total in session</td>
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<tr>
<td>12. Short break provided after first 10 trials</td>
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</table>
A. COMMUNICATION

1. What are the general expressive communication strategies used by or available to the person? These might include vocal speech, signs/gestures, communication boards/books, or electronic devices. How consistently are the strategies used?

_____________________________________________________________________
_____________________________________________________________________

2. What communication methods have been used with this person in the past? Has the child had any experience with Proloquo2Go?

_____________________________________________________________________
_____________________________________________________________________

3. On the following chart, indicate the behaviors the person uses to achieve the communicative outcomes listed:

<table>
<thead>
<tr>
<th>Communicative Functions</th>
<th>Complex speech</th>
<th>Multiple-word phrases</th>
<th>One-word utterances</th>
<th>Echolalia</th>
<th>Other vocalizing</th>
<th>Complex signing</th>
<th>Single signing</th>
<th>Pointing</th>
<th>Leading</th>
<th>Shakes head</th>
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<tbody>
<tr>
<td>Request attention</td>
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<td>Request help</td>
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<td>Request preferred items</td>
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<td>Show you something or some place</td>
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<tr>
<td>Indicate physical pain</td>
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<tr>
<td>Indicate confusion or unhappiness</td>
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<td>Protest or reject a situation or activity</td>
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<tr>
<th>Communicative Functions</th>
<th>Grabs/Reaches</th>
<th>Gives objects</th>
<th>Increased movement</th>
<th>Moves close to you</th>
<th>Moves away or leaves</th>
<th>Fixed gaze</th>
<th>Facial expressions</th>
<th>Aggression</th>
<th>Self-injury</th>
<th>Other</th>
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<td>Request attention</td>
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<td>Indicates yes or no</td>
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4. Does the person vocalize words or utilize approximations of words? If so, approximately how many? (Please list words and how the word is approximated?  

________________________________________________________________________

________________________________________________________________________
B. PROBLEM BEHAVIORS

1. List the child’s problem behaviors and the hypothesized functions.

_________________________________________  ___________________
  ________________________________________
  _________________________________________

2. Does the child engage in destructive problem behavior, such as throwing objects? If so, please list and describe the topography of the behavior.

_________________________________________  ___________________
  ________________________________________
  _________________________________________

3. Does the child engage in problem behavior associated with access to tangibles? If so, please list and describe the topography of the behavior.

_________________________________________  ___________________
  ________________________________________
  _________________________________________

C. SKILLS

1. Can the child extend his or her pointer finger?

_________________________________________

2. Has the child previously used a touch screen device? Was he or she successful in activating the device’s screen using his or her pointer finger?

_________________________________________
APPENDIX F: PARENT SOCIAL VALIDITY QUESTIONNAIRE
SOCIAL VALIDITY QUESTIONNAIRE

Directions: Rate how strongly you agree with the statement from weakest (1) to strongest (5).

Pre and Post-Study Items
1. I agree it is important to treat my child’s communication deficit.
   
   1  2  3  4  5

2. I find Apple technologies, like the iPad, to be an acceptable method for dealing with my child's communication deficit.
   
   1  2  3  4  5

3. I would be willing to use a procedure using an iPad with my child.
   
   1  2  3  4  5

4. The successful treatment of my child’s communication deficit will have beneficial effects for my family/community members and me.
   
   1  2  3  4  5

5. I agree it is important to conduct treatment in a way that determines the cause-effect relationship of the treatment and the treatment effect.
   
   1  2  3  4  5

6. I agree that for treatment to be considered successful it must be effective with other individuals.
   
   1  2  3  4  5

7. I agree that for treatment to be considered successful it must be effective in other settings.
   
   1  2  3  4  5

8. I believe it would be acceptable to use this treatment with individuals who cannot choose treatments for themselves.
   
   1  2  3  4  5

9. I believe that treatments using Apple technologies are likely to be effective.
   
   1  2  3  4  5
10. I agree it is important for participants/parents/guardians to answer questionnaires that address social validity.

11. I like the procedures used in this treatment.

12. I like the iPad system used in this treatment.

13. I believe this treatment is likely to result in permanent improvement.

14. I agree that the iPad training phase of the procedures was important/effective.

15. I agree that the prompt delay and vocal prompt phase was important/effective.

16. I agree that the outcome of this study will probably be successful with other individuals.

17. I agree that the behaviors my child learned during this study will probably be successful in other settings.

18. I agree that the outcome of my child’s involvement in this intervention was successful for him or her.

19. Overall, I have a positive reaction to this treatment.
California State University, Fresno

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<table>
<thead>
<tr>
<th>Gina Gavrilis</th>
</tr>
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<tbody>
<tr>
<td>Type full name as it appears on submission</td>
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<th>January 29, 2013</th>
</tr>
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