Teaching a Multi-step Requesting Sequence to Two Adolescents with Autism Using an iPod®-based Speech Generating Device

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Dedication

This thesis is dedicated to Navajo, my mother and Alexander. My mother's faith in me and continuous support is beyond words and kept me to push myself to the limits, which she always say, is infinite. For Navajo, I can not thank you enough for inspiring me and making me a better person. You have proven that autism is not merely a disorder, but a test to measure dedication, passion and love. We have moved mountains, my beloved son. For Alexander, thank you.

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And for Navajo, for his love, inspiration and showing me a completely different and beautiful way of thinking.

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Abstract

Many children with autism fail to develop speech and are therefore candidates for the use of speech-generating devices (SGDs). However, existing studies are limited because they have tended to focus only on teaching an initial single-step requesting sequence. This thesis aimed to extend the existing literature by evaluating intervention procedures for teaching two adolescents with autism to perform multi-step requesting sequences that required navigating across two screen pages (Intervention 1). Intervention 2 focused on teaching the adolescents to turn on and unlock the screen of the SGD prior to initiating the previously learnt multi-step requesting sequence. Both interventions made use of response prompting, prompt fading, and differential reinforcement procedures and were evaluated using the multiple-baseline across subjects design. Results showed that both interventions were effective in teaching these adolescents to use the iPod Touch® to make a sequence of requests. The results of the present study suggest that adolescents with autism can successfully learn to use an iPod Touch® to independently perform multi-step requesting sequences.

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CHAPTER I

INTRODUCTION

Autism, which falls under the umbrella of the Autism Spectrum Disorders (ASD), is a developmental disorder characterized by significant impairment in social interaction, communication development, the presence of repetitive patterns of behaviours, and a restricted range of interests (American Psychiatric Association [APA], 2000). These areas of deficits are recognized as a "triad of impairments", a concept of autism that was used by Rutter (1978) and Wing and Gould (1979). The symptoms of impairments in social interaction include problems in expressing nonverbal gestures, lack of social interests, and empathy. In the communication area, deficits include problems in language development, difficulties in the acquisition of speech, difficulties in establishing and maintaining conversations, and repetitive language. Indeed, many children with autism fail to develop any appreciable amont of speech and remain essentially mute throughout their lives (Ozonoff, Goodlin-Jones & Solomon, 2007). The third core feature of autism, repetitive patterns of behaviours and restricted range of interests, includes an obsession towards a certain routine, repetition of motor behaviours and a fixation towards detail of objects.

The percentage of children diagnosed with ASD increasing (Newsom & Hovanitz, 2006). What was initially reported as 20 in 10,000 children (Wing, 1993) is now considered to be 60 per 10,000 (Yeargin-Allsopp, 2003) or approximatley 1-2% of the population. The current prevalence of children diagnosed with ASD is 1 in 110 children (Centers for Disease Control and Prevention [CDC], 2010). ASD does not only affect the individuals with the diagnosis, but has a significant effect on the lives of their families, educational environments and the wider community. The lack of speech in individuals with autism makes them eligible candidates for Augmentative and Alternative Communication (AAC). AAC systems are designed to help individuals in expressive language (Mirenda, 2009a), either temporarily or permanently. There are a variety of AAC systems available, the choice of which depends on which system best suits the needs of its user.

A lot of precaution has to be taken into consideration before using a certain type of AAC. There is a wide range of new AAC systems available in the market. The decision to choose an AAC system must be made upon evidence-based practices. iPod®-based SGDs are beginning to show promising results in the field of ASD. However, not a lot of empirical evidence has been provided to support the successive use of this type of SGD and therefore further research is required. To date, empirical evidence suggests that children with autism are able to use this type of SGD to make requests of preferred items (van der Meer et al., 2010). However, most studies focused on teaching an initial single-step request sequence. To be able to use this AAC system more efficiently, the user should be able to operate the device in a sophisticated manner, for example, making a sequence of requests and navigating through the pages of device. Therefore, the purpose of this study was to extend previous literature by teaching adolescents with autism to use an iPod Touch® to make a sequence of requests and turn the device on.

Statement of the Problem

There have been numerous reports that the rates of ASD have risen in the past two decades (Newsom & Hovanitz, 2006). Current estimates suggest that 1 in 110 children are affected by ASD (CDC, 2010). With the impairments in social interaction, communication skills and behaviour flexibility (Folstein, 2006), it is very difficult for many adults with ASD to live independently. In order to help individuals with ASD move toward independence as adults, early intervention is essential (Bryson, Rogers & Fombonne, 2003; Harris & Handleman, 2000). Ideally early intervention treatments should be conducted intensively under professional supervision and supported by the individual's family (Johanson & Hastings, 2002; Sallows & Graupner, 1999).

For children with ASD, symptoms of deficits in communication might be severe speech delay, echolalia, or, in some cases, they may be completely non-verbal (Ozonoff, Goodlin-Jones & Solomon, 2007). AAC strategies are used to help people with speech impairment to develop more functional communication. AAC systems serve to replace speech, which helps language expression and reception (Murray & Goldbart, 2009). There are a variety of AAC options which are generally divided into unaided and aided (Mirenda, 2009a). Unaided systems of AAC refer to communication techniques which do not require an object or device to help the user to communicate, such as manual signing, pantomime, and gestures. The second type of AAC is aided, involves the use of exchanging pictures for a preferred item or activity (Picture Exchange Communication System [PECS], Bondy & Frost, 2001) and Speech Generating Devices (SGDs), also known as Voice Output Communication Aids (VOCA), which produce synthesized or digitized speech output associated with a symbol.

Despite a considerable amount of research demonstrating the usefulness of AAC, there have been some questions regarding the appropriateness of AAC. For example, if AAC acts as a replacement to normal speech would it discourage the child to actually learn how to speak? The evidence thus far suggests that the use of AAC has no impact on attainment of speech and in fact may help to develop speech in some individuals. Nonetheless, the decision of whether to use AAC is a delicate issue faced by parents, teachers and families of children with ASD (Mirenda, 2009a). However, what is important to remember is the main purpose of AAC, which is a system that allows individuals using it to establish and maintain an appropriate form of communication. In other words, AAC may act as an alternative to speech and an aid for language that acts in the interim while speech is severely delayed or even absent. The role of AAC systems as a form of functional communication will often decrease anxiety or problem behaviours in children with ASD from not being able to communicate appropriately.

The raising challenge for clinicians, practitioners, teachers, parents and caregivers of children with ASD is to find evidence-based practices that suit the needs of these children. Children with autism lack speech and therefore are candidates for AAC. Considering there are a lot of AAC options available in the market, it is important to take into account that some children with autism might not be able to use certain types of AAC systems. Before choosing a particular AAC system, one needs to seek empirical evidence of how compatible the chosen system is with the characteristic of the user. It is proposed that the iPod Touch® with the Proloquo2Go™ software might be the alternative solution as a promising AAC system. Its compact size, touch screen, large repertoire of vocabulary, intelligible synthesized speech output and relatively low-cost nominal value compared to other speech generating devices in the market are just several positive points of this particular device. However, more empirical evidence is needed in order to study its efficacy.

Purpose of the Study

The purpose of the current study was to teach adolescents with autism to make a sequence of requests by navigating through the pages on the iPod-based® SGD and also activate the device independently. To date, studies on teaching children with developmental disabilities to use the iPod® as an SGD have been limited to making a simple single-response request for a preferred item (Kagohara et al., in press, van der Meer et al., 2010). The current study extends previous studies on this particular type of SGD by providing empirical evidence of teaching two adolescents to use an iPod® Touch for multi-step requesting sequences.

Significance of the Study

With the rapid increase in the prevalence of children diagnosed with ASD, the need to continue providing evidence-based practices in the field of ASD is evident. It is likely that practitioners and caregivers of children with ASD would benefit greatly from additional empirical evidence with regard to effective interventions in order for them to develop more constructive programs for children with special needs. For children with autism, their lack of speech makes them eligible as candidates for AAC. The iPod ®-based SGD seems to be a promising device, however the evidence thus far is limited to two known studies (i.e., Kagohara et al., in press; van der Meer et al., 2010). These studies have demonstrated successful teaching of children with autism to use of this type of SGD. However, recent studies only taught the children to make a simple request on the iPod ®-based SGD. The current study extends previous research on AAC systems, particularly in regards to iPod ®-based SGDs, which would contribute in providing empirical evidence to the field of special education needed by clinicians, practitioners and caregivers of children with autism to help these children overcome their lack of speech.

Research Questions

The research questions addressed in the current study were;

1. Can children with ASD be taught how to navigate through the pages of the iPod Touch® to make a sequence of requests?

2. Can these children be taught how to activate the device?

CHAPTER 2

LITERATURE REVIEW

The History of Autism

In 1943, Kanner (1971, 1973) provided the first description of children with autism. In this initial description, Kanner provided detailed case histories and symptom descriptions for 11 children, aged from 2 to 8 years old, and used the term “early infantile autism”. All of these children showed similar patterns of behaviour, which were the inability to form appropriate affectionate relationships with others since the early stages of their lives and fixation with a certain routines or rituals. Kanner also reported that these children appeared to show an inability to engage in a normal conversation. However, Kanner did not specifically note language impairment as a core criterion of autism.

Kanner’s term of “early infantile autism” is no longer used today. Autism Spectrum Disorder (ASD) is now recognized as an umbrella that encompasses several developmental disorders that relate to autism symptoms such as Classical Autism, Asperger Syndrome and Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS). ASD is defined as a developmental disorder characterized by significant impairment in social interaction, communication development, and the presence of repetitive patterns of behaviours and a restricted range of interests (American Psychiatric Association [APA], 2000). Furthermore on the diagnostic criteria, the International Classification of Diseases 10th revision (ICD-10; World Health Organization, 1993) defines autism as part of a pervasive developmental disorder which is characterized by deficits in three areas: namely social interaction, communication and behaviours, and interests. These areas of deficits are also recognized as a “triad of impairments” (Rutter, 1978; Wing & Gould, 1979). The symptoms of impairments in social interaction include problems in expressing nonverbal gestures, lack of social interests, and lack of empathy. In the communication area, deficits include problems in language development, difficulties in establishing and maintaining conversations and repetitive language. Abnormal functioning in behaviours includes an obsession towards a certain routine, repetition of motor behaviours and a fixation on the details of particular objects.

The symptoms of ASD are evident in the early stages of life (Mirenda, 2009a), usually starting from 2 or 3 years old. Parents of children with ASD might report delay or lack of certain developmental milestones in their children compared to others. The triad of impairments ususally becomes obvious at this age, because at this stage of development, a child would usually establish basic receptive and expressive language, an interest in interacting with others and an interest in play. It is also usually during this age period when parents seek further explanations and diagnosis for their children and when early intervention treatment starts (Bryson, Rogers, & Fombonne, 2003; Harris & Handleman, 2000). Early intervention for children with ASD is crucial in order to promote functional adaptive skills. It requires professionals and practitioners to find the best model to fit the stakeholder’s needs (Odom, Boyd, Hall & Hume, 2010). The major intervention that is usually applied in teaching children with ASD or other learning disorders is discrete-trials treatment (DTT; Lovaas, 2003). DTT has been used extensively in teaching various skills to children with ASD and other developmental disabilities. DTT adopts procedures of operant discrimination-learning, where a certain skill is simplified and taught in repeated trials, with a limited time for each trials, delivered in a one-to-one session where the stimuli is chosen by the trainer.

According to numerous reports, the prevalence of ASD has risen in the past two decades (Newsom & Hovanitz, 2006). Wing (1993) reported the prevalence was 20 per 10,000 children. The current estimation by the Centers for Disease Control and Prevention (CDC) of the U.S. Department of Health and Human Services is 60 per 10,000 children (Yeargin-Allsopp, 2003). Studies have suggested that there is a higher ratio of boys than girls with ASD with ratios ranging from 1.8:1 (Fombonne, du Mazaubrun, Cans & Grandjean, 1997) to 15.7:1 (Baird et al., 2000). Currently, the prevalence of children diagnosed with ASD is 1 in 110 children (CDC, 2010). The increased rate of ASDs must be carefully interpreted. This finding does not necessarily mean that cases of ASDs have drastically increased per se (Newsom & Hovanitz, 2006). We should also take into account that the diagnostics of ASDs have been broadened during the past decades. As opposed to the earlier edition, DSM-III (APA, 1980), the DSM-III-R (APA, 1987) provided broader criteria of ASDs, which allowed more people to fall into this category. What was categorised with limited diagnostic criteria has been expanded to a list of symptoms. The increase of these rates might also be due to the widespread awareness of ASD which is not limited to parents and teachers, but also amongst wider sections of the community.

Other symptoms that are also shown in some individuals with ASD are impairment in sensory integration, attention deficit disorder (ADD), attention deficit hyperactivity disorder (ADHD), intellectual disability and other learning disabilities (Ozonoff, Goodlin-Jones & Solomon, 2007). Sensory integration issues might be hypersensitivity or hyposensitivity in vision, hearing, smell, sight and sensation. Every child with ASD vary in their diagnosis, which makes it crucial for clinicians, professionals and teachers to design a specific program for each child, it is not possible to make a general intervention program that would fit every children with ASD.

Although the symptoms of ASD differ from one child with another, most parents of children with ASD will notice some behaviour of their child that does not occur in most of their peers. The early symptoms of autism include, but are not limited to, an inadequate form of receptive and expressive language, poor eye contact, lack of interest in peers, aggression, temper tantrums, an odd way of playing and a fixation towards detail (APA, 2000).

With the impairments in social interaction, communication skills and behaviour flexibility (Folstein, 2006), it is very difficult for children with ASD to be able to live independently. In order to help these children achieve a constructive result, these children heavily rely on early intervention treatments (Bryson, Rogers & Fombonne, 2003; Harris & Handleman, 2000; Mirenda, 2009a), which ideally should be conducted intensively with strict supervision by a professional and supported by their family (Johanson & Hastings, 2002; Sallows & Graupner, 1999).

Augmentative and Alternative Communication (AAC)

Communication impairment is one of the main symptoms in the diagnosis of autism (APA, 2000) although the symptoms might vary widely from one individual to another. Symptoms of deficits in communication might be severe speech delay, echolalia, or, in some cases, completely mute (Ozonoff, Goodlin-Jones & Solomon, 2007). Children with autism whom lack speech are most likely to benefit from AAC to help them communicate, either temporarily or permanently (Mirenda, 2009a).

AAC consists of unaided and aided systems. Unaided AAC systems are systems which do not require the stakeholder to use an instrument or device. An example of unaided system is manual signing. Aided AAC systems are systems that involve the usage of an apparatus or device by the stakeholder. Picture exchange communication system (PECS; Bondy & Frost, 2001) and speech outputs or speech generating devices (SGDs; Colby 1973) are two of the common aided AAC systems that are currently used. The history of these AAC systems, along with the research involving them and strength and weaknesses of each system can be summarized by Lancioni et al.'s review (2007) below.

Sign Language. Lancioni and colleagues noted that sign language was initially introduced as a method to substitute speech for those with communication deficits. However, sign language was found to be inefficient because to learn to use sign language properly, one must be trained for a significant amount of time. Also, the partner of this type of communication is limited to people who understand sign language. These limitations challenged researchers to find other types of communication aids which can be used immediately by the user and can be easily understood and accepted by the community in order to make requests.

Picture Exchange Communication System (PECS) was then considered as an alternative solution. PECS is an exchange of a picture with a desirable object. Many studies have been conducted to assess the effectiveness of PECS. In Lancioni et al.'s (2007) literature review on PECS for making requests, it was suggested that studies showed PECS was suggested as an effective tool to meet this particular need. Similar founding was reported by Preston and Carter (2009) in their empirical review of the effectiveness of PECS. PECS was found to be an effective means of communication for people with functional speech disabilities to make a request spontaneously. However, the complexity of making a request requires an equally thorough set of PECS, making it inefficient to carry around and flip through a big pile of pictures. Another limitation of using PECS is that the communication partner needs to be in close proximity to the PECS user in order to understand what the person is requesting.

Research then led to Speech Generating Devices (SGDs), such as Voice Output Communication Aids (VOCAs) as a solution to the limitations of PECS. VOCA is a device that translates symbols into synthesised messages (Lancioni et al., 2007). The person operating an SGD can push a button or a picture to then produce a sound that represents the meaning of those pictures. Further research then compared the efficacy of PECS and SGDs (Lancioni et al., 2007; Son, Sigafoos, O'Reilly & Lancioni, 2005). The results suggested that both PECS and SGDs were found effective in order to make a request. However, most of these studies were conducted to make a simple or single request without teaching the SGD users sophisticated skills to navigate through the SGD.

SGDs are increasingly being used as augmentative and alternative communication options for individuals with developmental disabilities who have limited or no spoken language (Lancioni et al., 2007; Mirenda, 2003; Schlosser & Blischak, 2001; Sigafoos, Didden, & O'Reilly, 2003). SGDs typically consist of a computer-based processing unit with a visual display. The visual display might hold a number of vocabulary items (e.g., photographs, line drawings, or printed words) that produce digitised (i.e., recorded) or synthesised speech output when selected. Touching the line drawing of a glass of water, for example, might produce speech output such as "*I would like to have a drink of water please*."

The important fact to remember about choosing a certain AAC system for a child with autism or other developmental disability is to always take into account that there is no specific system that will fit the needs of every single child. Each individual is unique, therefore it is a challenge for clinicians, practitioners, teachers and parents of children with autism to find the appropriate AAC system that is tailor-made to meet the child's needs.

Empirical Evidence Related to the Use of SGDs for Children with ASD

Empirical evidence of SGDs used as an effective system in communication intervention for people with developmental disabilities was provided by a recent review (van der Meer & Rispoli, 2010). Van der Meer and Rispoli (2010) conducted a review on 23 studies involving teaching children with ASD to use various types of SGD for functional use. The main tasks were making requests, establishing conversations, and providing general comments. These studies involved 51 children in total (3 to 6 years of age) all of which were diagnosed with ASD. The review concluded that 78% of the studies showed positive results of children with ASD being able to learn to use various types of SGDs to establish a more functional form of communication. This study provides empirical support that SGDs are proven to be an effective system in communication interventions for individuals with a wide range of developmental disabilities.

Despite this empirical evidence that individuals with developmental disabilities who lack speech can be taught to successfully use SGDs to establish functional communication, the important issue to remember is that such individuals may not be able to be successfully taught to use all types of SGDs. SGDs differ in many ways, such as their complexity to operate, the size of the inventory, the sophistication of the speech output, the size of the actual device, and so forth. Such differences may cause difficulties for individuals with certain developmental disabilities to be taught to use it.

Researchers are facing a continuing challenge to find other devices as a solution to making requests for people with communication problems. iPod Touch® is considered to be a promising alternative compared to the previous SGDs. There are numerous advantages of using the iPod Touch® as a communication aid. First of all, it is easy to use as it operates via a touch screen. Also, not many buttons are involved with this particular device. The selection is made by pressing the icons on the screen. Second, similar to the other SGDs, it can generate a synthesised verbal message which can act as a model for the participant to learn to copy. Third, it is fairly affordable, compared to previous SGDs. Fourth, its compact design makes it easy to carry around. Fifth, this device can also be used for other means than purely as a communication aid. A lot of applications can be easily downloaded onto this device, such as auditory and visual academic lessons, music, games, videos, electronic books and so forth. With the Wi-Fi technology integrated in this device, the user can also access the internet. Studies on the benefits of this device in enhancing social skills and leisure for developmentally disabled individuals have been reported (Marks & Milne, 2008).

The iPod Touch® as the SGD, with an AAC application called Proloquo2Go™ was used in this present study. iPod Touch® is a touch screen device that can produce synthesised and digitised sounds, as well as high resolution pictures and videos. With the Proloquo2Go™, the user only needs to tap lightly on the icon he/she prefers to produce the corresponding synthesised speech output. There are two general ways to operate the Proloquo2Go™ application. First, by using its repertoire of 8,000 picture symbols; this method produces a single word synthesised speech output which is associated to the picture symbols. Second, by typing in a word or a sentence, this feature is highly beneficial so that the user can easily construct their own sentences depending on their needs. There are also four different synthesised voices that can be chosen; a male adult, a female adult, a boy and a girl. These features, along with the high portability and the low cost of obtaining the iPod Touch® and Proloquo2Go™ ($200 and $300, respectively) compared to other SGDs in the market, are advantageous for people using this type of SGD (Mirenda, 2009). Although this device has numerous advantages for the field of autism, more research needs to be done to study how the iPod Touch® can improve social skills of individuals with autism. For instance, the video feature of this device might be used to teach individuals with autism social skills through video modelling.

Anecdotal findings have been reported on the success of children with autism using Proloquo2Go™ to communicate (Sennott & Bowker, 2009). Although anecdotal reports might be encouraging, there needs to be empirical evidence to support the idea that individuals with developmental disabilities can successfully be taught to use this type of SGD to establish a form of functional communication, such as requesting access to preferred items. The implication of providing empirical data on whether individuals with developmental disabilities can be taught to use an iPod Touch®-based SGD would be highly beneficial for parents, caregivers and clinicians of such people. They can make more evidence-based decisions regarding the suitability of the use of this device as an effective AAC system.

Empirical Evidence for the Use of an iPod®-based SGD

Impairment in communication, the lack of speech in children and difficulties in mastering receptive and expressive language skills make them to show the tendency of being visually oriented. Research has shown that children with ASD work better with visual stimuli in completing tasks, where pictures replace verbal language. This has lead researchers to find visually oriented AAC systems to help these children form a more functional communication. The iPod Touch® with the Proloquo2Go™ software provides a promising solution to this issue. This particular device is operated with a touch screen where all the applications are represented with icons. The Proloquo2Go™ also presents icons and can be programmed to produce custom-made sentences. This feature is beneficial for advanced users, for example individuals whom lack speech but are capable to read and write. These are just two of the many positive points of using this type of SGD.

To date, there appears to be only two studies on teaching children with ASD how to use the Proloquo2Go™ on an iPod Touch® (Kagohara et al., in press; van der Meer et al., 2010). The study conducted by van der Meer et al. (2010) on three participants with developmental disabilities was aimed to teach them the functional use of using an iPod Touch® to make requests of preferred items. Two male adolescents and one female adult participated in this study. With a multiple probe experimental design, van der Meer et al. conducted the intervention in three phases; namely baseline, acquisition training and follow-up. Results showed that the intervention design of the study involved Acquisition

Training procedures which included graduated guidance, time delay and differential reinforcement were effective in teaching some individuals with developmental disabilities to use the iPod Touch® as a communication aid in requesting. One participant did not show significant skill acquisition and did not complete participating in the study. The intervention methods used in this study applied specific instructional technique that are proven to show promising results in teaching new skills for individuals with developmental disabilities (Duker, Didden & Sigafoos, 2004).

Furthermore, a study by Kagohara et al. (in press) provided empirical evidence of teaching an adolescent with autism to operate the iPod Touch® appropriately. The participant was a 17-year-old male with a history of autism. The participant showed difficulties in operating the device independently to make a request. Intervention in Kagohara et al. study involved differential reinforcement and delayed prompting. Results showed that what was initially thought as a motor incapability to be able to operate the iPod Touch® can actually be shaped towards a successful use of the SGD by applying behavioural intervention. Differential reinforcement and delayed prompting were effective in teaching the participant to operate the device successfully. The intervention methods in Kagohara's study also applied similar teaching techniques as van der Meer et al.'s (2010) study.

Although the numbers or participants in both of the aforementioned studies are quite limited, they show promising results of using the iPod Touch® as a communication aid for individuals with autism. However, it is important to remember that these studies were limited to teaching the participants to make a single request. The teaching techniques used in these studies are methods that have been extensively used for teaching individuals developmental disabilities (Duker, Didden & Sigafoos, 2004). By using specific and systematic instructional strategies, the participants in both studies acquired new skills. The present study was designed to extend previous research, by focusing on developing the sophistication of the children's skills, by teaching children with ASD how to navigate through the iPod Touch® to make a sequence of requests. Furthermore, this study was aimed to children to activate the device without the aid of another person. All of these skills are needed to use the iPod Touch® independently and to an optimum capability. By teaching the participants to use this SGD to communicate in a more functional manner and will help replace pre-linguistic communicating attempts and decease challenging behaviour.

The significant impact of communication deficits for children with ASD, parents, teachers and the wider community has drawn attention to finding better ways to help these children communicate. This particular research project was formulated because a successful result will have significant implications to the field of Autism and mental disability more generally. To date, there appears to be only two other studies (Kagohara et al., in press; van der Meer et al., 2010) that teaches children with ASD how to make a request using an iPod Touch®. However, the skills that were taught did not focus on helping the children use the iPod Touch® as an SGD in a more sophisticated manner. No empirical research involving activating and navigating through the device to make a sequence of requests and the iPod Touch® was found. Furthermore, the iPod Touch® is a relatively new SGD in the AAC field, and advanced research needs to be done to study its effectiveness as an SGD for children with ASD.

The present study was aimed to provide empirical findings that hopefully will benefit and enrich the field of AAC and ASD. The purpose of the study was to teach children with ASD activate the iPod Touch® to navigate to the correct pages to make a sequence of requests. This research will have significant implications for the use of cutting edge technology for communication and offer suggestions of methods that can be used effectively by children with ASD.

Applying the principles of backward chaining method of teaching, the present study addressed the following questions; can children with ASD be taught how to activate the iPod Touch® and can children with ASD be taught to navigate through the pages make a sequence of requests using the iPod Touch®?

To answer these research questions, this project involved two related interventions.

Intervention 1: Teaching children with ASD to navigate through the pages and make a sequence of requests.

Intervention 2: Teaching children with ASD to activate the iPod touch®.

CHAPTER 3

METHOD

Prior to beginning this project, ethical clearance to undertake the study was obtained by the Victoria University of Wellington Faculty of Education Ethics Committee on 3 March 2010 (reference number SEPP/2009/43: RM 16778 - Addendum SEPP/2010/07. In addition, prior to data collection, informed consent was obtained from the participants' parents. Informed consent was also obtained by the participants' teacher and the school principal to undertake the project with the the participants' in their classroom.

Participants

The participants were two male students who attended a special needs school. Both participants met the following criteria: (a) a history of autism diagnosis or a related intellectual/developmental disability, (b) expressive language age equivalence of less than 2.5 years, (c) no physical or sensory impairments that would prevent them from operating the SGD, (d) prior exposure to SGD training, specifically using the Proloquo2Go™ on the iPod Touch®, and (e) nomination by their classroom teacher as a candidate for SGD training. Both participants were referred by their teacher for this study because they had little or no speech.

Sam was a 13-year-old male diagnosed with autism and severe intellectual disability. The Communication sub-domain of the Vineland-II Adaptive Behaviour Scales (Sparrow, Cicchetti & Balla, 2005), is used to assess receptive, expressive and written communication. On this assessment, Sam is reported to have the age equivalencies of 1:11 (years:months), 1:4, and 4:6, respectively. During pre-baseline observations Sam rarely spoke and used unintelligible communication to communicate. His teacher also reported that Sam had limited social skills and engages in frequent problem behaviour (e.g., hitting, kicking, and running out of the classroom).

Steven was a 17-year-old male diagnosed with autism, Obsessive Compulsive Disorder (OCD) and Attention Deficit Hyperactivity Disorder (ADHD). On the Vineland-II Adaptive Behavior Scales (Sparrow, Cicchetti, & Balla, 2005), he received age equivalencies of 2:1 (years:months), 0:8 and 6:9 for receptive, expressive, and written communication, respectively. Informal classroom observations prior to the baseline showed that Steven communication was limited to pointing, gestures, vocalizations, and a few unintelligible single words. He was reported to be able comply with simple to 2 and 3-word instructions. Steven had limited social skills and engaged in impulsive, repetitive, aggressive, and self-injurious behaviour (e.g., slapping the side of his head and biting his hands).

Prior Intervention History

Sam and Steven had previously been taught to use the Proloquo2Go™ on an iPod Touch® to make a single-response request sequence as described in an earlier study (Kagohara et al., in press; van der Meer et al., 2010). Both Sam and Steven participated in van der Meer et al.'s study of teaching them the functional use of this device to make a request of preferred items in a delayed-multiple probe design with four phases (baseline, acquisition training, post-training and follow-up). Acquisition training involved graduated guidance, time delay and differential reinforcement procedures. Results showed that the intervention was effective in teaching Sam and Steven the functional use of the iPod Touch® using the Proloquo2Go™ software. They rapidly acquired the skills taught during the intervention.

Steven participated in the later study conducted by Kagohara et al. (in press). This particular study was aimed to teach Steven the fine-motor skill to be able to operate the iPod Touch® independently. Initially, Steven seems to find it difficult to activate the SGD which was interpreted as a fine-motor disability. However, behavioural intervention which consisted of differential reinforcement and delayed prompting was conducted to teach the skills of gently tapping the icon on the screen to operate the iPod Touch®. Results showed that this type of intervention was effective in teaching the fine motor skills required to operate the iPod Touch® as an SGD.

Materials

Preferred Stimuli

Prefered stimuli that the participants were taught to request were indentified and validated using a two-step process. First, the teacher of the participants was asked to make a list of snacks and toys that the participants seemed to prefer and which would be appropriate for the participants to request during the classroom snack activity. For Step 2, the items identified by the teacher were offerred several times in 5 min period sessions. Preferred stimuli (e.g., potato chips, cookies, sweet treats, a miniature soccer ball, a train-themed drawing book, and a toy car) were identified in the previous study (Kagohara et al., in press; van der Meer et al., 2010). Aforementioned studies showed that Steven showed high interest snacks (potato chips, cookies and sweet treats) and Sam was particularly interested in one type of sweet treats.

Speech Generating Device

The SGD used in the present study was an Apple iPod Touch® second generation with Proloquo2Go™ software installed to it (see Figure 1). The iPod Touch® was attached to the iMainGo™ speaker. Participants have already been taught to request preferred stimuli using the iPod Touch® with Proloquo2Go™ software in the previous study (Kagohara et al., in press; van der Meer et al., 2010). The iPod Touch® was placed inside an iMainGo®2 speaker case to increase sound amplification.

Prior to the study, the iPod Touch® was programmed to show a single page containing two graphic symbols, representing general requests for snacks and toys. Touching each symbol activated corresponding synthetic speech-output (i.e., "*I want to eat*.", "*I want to play with a toy*.", *"I want chips."*, *"I want a cookie."*, *"I want a lolly."*, *"I want to play with a car."*, *"I want to play with a ball."*, *"I want a book."*).

Experimental Design

Following the principles of the backward chaining teaching method, students were taught to make a sequence of requests (Intervention 1) then they were taught to turn on the SGD (Intervention 2). Both interventions employed a multiple baseline across subjects design (Kennedy, 2005), involving the following phases: baseline, intervention and follow-up. Intervention phase consisted of implementing graduated guidance and time delay in a one-to-one training situation. These are well-established strategies of teaching individuals with developmental disabilities (Duker, Didden, & Sigafoos, 2004). One to three sessions (with the duration of 5 min per session) were held two days per week during baseline and Acquisition Training. However, during post-training/follow-up, only one session was held once a week (5 min per session). For all sessions in each phase, the participant was seated next to two observers/data collector/trainer and occasionally a third observer was nearby.

Figure 1. Pictures of the iPod Touch® for the present study. The device used in this study is an iPod Touch® second generation with the Proloquo2Go™ application. The iPod Touch® is attached to the iMainGo®2 speaker. This picture shows the screens of the stages that were used in the present study; from turning on the device, unlocking the screen and making a sequence of requests.

Procedures

Intervention 1: Navigating the SGD and making sequence of requests

For *Baseline*, the iPod touch® was placed in front of the participant, with the first page on display (see Figure 1), showing a picture of "*I want to eat*" and "*I want to play with a toy*". The trainer asked:"*Let me know if you want something*". After every 30 s, both trays were moved towards the participant so that they could take one item from the tray, regardless of their response. This method is referred to as a 30-s fixed-time schedule of reinforcement. It is an important technique because it acts as a motivator for the participant to keep engaged in the session.

During *Acquisition Training,* with the iPod Touch® placed in front of the participant and both trays containing preferred snacks and toys visible but out of reach, the trainer asked:"*Let me know if you want something*". The iPod Touch® displayed the first page, showing a picture of "*I want to eat*" and "*I want to play with a toy*". If the participant did not touch an icon after 5 s of the verbal cue, the primary observer would use verbal and gestural prompting by saying "*Touch this icon*" and point to the icon to teach the participant to touch the icon to make a request. If the participant continued to fail to make the appropriate response after a 10 s delay, the secondary observer conducted a physical guidance prompting, by holding the participants right hand, isolating the index finger and physically guided the participant to touch an icon on the displayed page so that the iPod Touch® produced the synthesised sound associated to the icons. For the physical guidance phase, the secondary observer physically prompted the participant to choose the "*I want to eat*" icon. This decision is based upon the preference assessment that was conducted in a previous study where both participants showed the tendency to choose snacks rather than toys.

After an icon on the first page was touched, the iPod Touch® displayed the second page which contained icons of the items in the tray that is associated with the choice they made previously on the first page. For example, if the participant chose the "*I want to play*" icon, the page following this request would show 3 icons of toys presented in the tray (i.e. book, miniature ball and toy car) which, when selected, produced synthesised sounds "*I want to read a book*", "*I want to play with the ball*" and "*I want to play with the car*" respectively. If the participant chose the icon for snacks, the second page displayed three items of snacks, in this case a cookie, potato chips and candies with the synthesised sounds of "*I want a cookie*", "*I want a chip*" and "*I want a lolly*" for each icon, respectively.

Figure 2. Pictures of the iPod Touch® for Intervention 1. The pictures are showing the screens used in Intervention 1, making 2-step requests and navigating through the correct pages on the device.

When the second page was displayed, the primary observer asked the participant "*Let me know what you want to play with*" or "*Let me know what you want to eat*" based on the participants choice on the first page. If the participant failed to make an appropriate request after a 5 s delay following the verbal cue, the primary observer executed a verbal and gestural prompt by saying "*Touch this icon*" while pointing to a specific icon. A 10 s delay was inserted following the verbal and gestural prompt then the secondary observer engaged in the physical guidance if the participant continued to fail to make the appropriate response which was similar to the physical guidance on the first page.

Immediately after the synthesised speech was produced, the primary observer moved the tray which contained the requested item towards the participant so that they could take one item from the tray and allow the participant 10 to 15 s to finish the snack or play with the toy. The primary observer moved the tray back to its initial position with the snacks replenished and the toy back on the tray.

The primary observer continued with the next trial by asking the participant "*Let me know if you want something*". The main task for the participant to complete was touching the *Back* button on the second page (which was currently displayed) in order for them to go to the first page and make a new request. A 10s delay was inserted following the verbal cue of the primary observer before the primary observer engaged in a verbal and gestural prompt "*Touch the back button*". Another 10s delay was inserted before the secondary observer executed a physical guidance (similar to the previous ones) to physically guide the participant to lightly touch the *Back* button displayed on the screen.

The participant's independent action of the touching the *Back* button on the second page was recorded as a success completion of one trial.

Intervention 2: Activating the SGD

During *Baseline*, the participant was given the iPod Touch® turned off. The primary observer said to the participant "*Turn on the iPod®*". After a 30s delay, the primary observer took the iPod Touch® away from the participant so that it was not visible by the participant. The primary observer then turned on the iPod Touch® by touching the Home button and unlocked the screen by sliding the arrow across the screen. The iPod Touch® was placed in front of the participant again to continue with Intervention 1.

Figure 3. Pictures of the iPod Touch® used in Intervention 2. Pictures show the device turned off and unlocked screen.

Similar to the Acquisition Training phase on Intervention 1, *Acquisition Training* for Intervention 2 had two steps using delayed and least-to-most prompting. The procedure is as follows. The iPod Touch® was placed in front of the participant turned off. The primary observer said "*Turn on the iPod®*". A 5s delay was inserted following the verbal cue. If the participant failed to perform the appropriate response, which was pressing the Home button, the primary observer prompted a verbal and gestural cue *"Press the Home button"* while pointing to the Home button. Another 10 s delay was inserted after the verbal and gestural prompt. If the participant continued to fail to make the appropriate response after 10 s, the secondary observer conducted a physical guidance prompting, by holding the participants right hand, isolating the index finger and physically guided the participant to touch the Home button on the iPod Touch® which turned on the device. Touching the Home button brought the participant to a screen showing that the device was still locked.

After the iPod Touch® was turned on, the primary observer asked the participant *"Can you unlock the screen?"* A 5 s delay was inserted following the primary observer's verbal cue. If the participant failed to make the appropriate response, which was sliding the arrow across the screen, the primary observer executed a verbal and gestural prompt by saying "*Slide the arrow across the screen*" while pointing to the device and making a sliding gesture in the air with her finger. A 10 s delay was inserted after this prompt. If the participant failed to make the required response, the secondary observer engaged in the physical guidance by holding the participants right hand, isolating the index finger and physically guided the participant to slide the arrow across the screen of the iPod Touch®.

The participant's independent action of the unlocking the screen was recorded as a success completion of the trial. Only one trial was conducted every 5 min session. After unlocking the screen, the first page of the requesting task appeared and the Acquisition Training phase of Intervention 1 continued.

Follow-up. Steven was included in three follow-up sessions and Sam had five follow-up sessions, both conducted 1 week after Session 42. The follow-up procedures included tasks of both studies, with 1 or 2 trials for each session. Each session is 5 mins long. For this phase, if the participant failed to perform the required response, no prompts were given. The primary observer took the device out of the participant's vision, perform the task then return the device to the participant and continue with the next task.

The procedure is as follows. The first stage of this phase was instructing to participant to navigate the SGD. The participant was given the iPod Touch® turned-off. The primary observer asked the participant *"Can you turn on the iPod®?"*. After the participant has finished completing the task, the primary observer then asked "*Can you unlock the screen?*". Completing the first and second task independently was recorded as a success completion of the trial. After the screen was unlocked the first page for requesting was displayed. The participant was immediately instructed to make a sequence of request, which was the second stage of the follow-up phase. The primary observer asked the participant *"Let me know if you want something"*. After the participant made a request and the synthesised speech was produced, the device displayed the second screen, which displayed 3 specific items. The primary observer asked the participant "*What do you want to eat?*" or "*What do you want to play with?*" according to the symbol selected by the participant. After the participant made a request and the synthesised speech was produced, the primary observer moved the tray containing the requested item towards the participant, let the participant to take the item from the tray then take the tray away from the participant's reach and replenished the tray. The participant was given 10 to 15 s to finish eating the snack or playing with the toy then the primary observer asked the participant “*Let me know if you want something*” and the participant was required to touch the Back button to make a new request. Touching the Back button independently was recorded as a success completion of the trial.

Inter-observer Agreement

Two to three observers were present across all sessions. The primary and secondary observer recorded the number and type of responses (i.e. independent or prompted) for all the sessions during all phases of both studies.

For every 5-min session, the agreement of the number and type of responses between the observers were calculated as follows. For Baseline, only the number of responses was calculated, and the overall percentage of agreement was calculated following the formula: Smaller Number/Larger Number x 100%. For Acquisition Training and Follow-up, both observers recorded the number successful responses.

For Steven, Agreement during Baseline of Intervention 1 showed a mean of 100%. Agreement during Acquisition Training sessions ranged from 0 to 100%, with an overall mean of 92.86%. There was one session when the primary observer recorded no successful response while the secondary observer recorded one successful response. During the Follow-up, the Agreement ranged from 97.36 to 100%, with a mean of 98.04%. For Intervention 2, the Agreements during Baseline, Acquisition Training and Follow-up were 100%.

For Sam, Agreement during Baseline of Intervention 1 was 100%. Agreement during Acquisition Training ranged from 80 to 100%, with an overall mean of 96.9%. For Follow-up, the Agreement ranged from 75 to 100%, with a mean of 92.59%. For Intervention 2, the Agreement for Baseline, Acquisition Training and Follow-up was 100%.

Treatment Integrity

Treatment Integrity was assessed by the secondary observer based on the checklist in which the primary observer has noted prior to the session. The secondary observer recorded how the primary observer followed the procedures appropriately.

For Steven, Treatment integrity was recorded by the secondary observer during 87.17% of the Baseline, Acquisition Training an Follow-up sessions across the two studies. For Sam, Treatment Integrity was 100% for all the phases across the two studies.

Inter-observer Agreement on Treatment Integrity

Inter-observer Agreement on Treatment Integrity was assessed by a third observer, by recording the Agreement on the Treatment Integrity which was recorded by the secondary observer. For Steven, Inter-observer Agreement on Treatment Integrity was recorded for 17.94% of the overall sessions, reaching 87.5% Agreement. Meanwhile for Sam, Inter-observer Agreement was recorded for 24.32% of the overall sessions, with 100% Agreement.

CHAPTER 4

RESULTS

Figure 2 shows the number successful responses for each 5-min session. The dotted marks represent results of Intervention 1, which are the numbers of successful responses in independently touching the Back button in order to make a sequence of request. The bars are results of Intervention 2, reflecting the successful responses of performing 2 steps of navigating the iPod Touch®. The dotted marks are plotted to the right axis and the bars are plotted to left axis.

As presented in the graph, during Baseline for Intervention 1, both participants were not able to make a successive sequence of request. They did, however, make a partial of the sequence, by successfully completing the first page but then stopped at the second page without being able to return to the first page in order to make another request. Over the 6 Baseline sessions, Steven showed an average of 12.67 per 5 min session unsuccessful attempts to make a request. Meanwhile, Sam made an average of 60.67 errors across the 3 sessions.

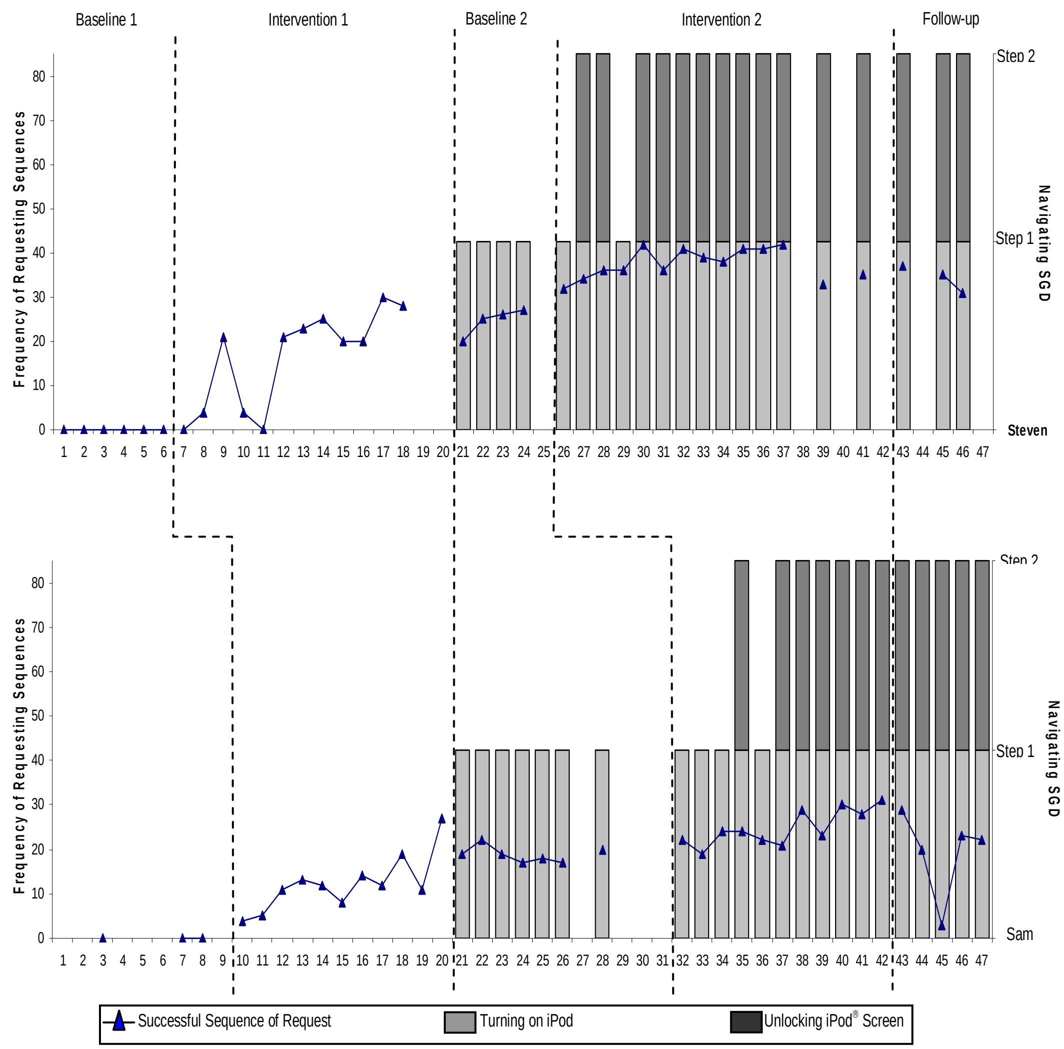

Figure 4. Results for Intervention 1 and 2. The dots represent the frequency of successful independent responses in making a sequence of requests. The bars represent responses in completing the two steps of activating the SGD.

Results indicated that during Acquisition Training, Steven achieved adequate acquisition of independently making a sequence of requests on the third session of training. The decrease in his acquisition on the fourth session was due to his current state which was not conducive for training. Acquisition was recorded as 0 on the fifth training session due to the incorrect verbal prompting. Instead of instructing "*Push the Back button*", the primary observer said "*Go Back*", which made Steven get up from his chair and move away from the observers towards the other side of the room. Steven showed a consistently high number of acquisitions starting from the sixth session of training until the end of the Follow-up phase. Sam achieved acquisition starting from the third session of Acquisition Training and gradually showed a stable increase until the end of Follow-up. The numbers of errors to make requests also showed a significant decrease during the Acquisition Training phase compared to the baseline phase with means of 0.82 and 1.41 for Steven and Sam respectively.

Results for Intervention 2 showed that during all Baseline sessions, both Steven and Sam showed attempts to complete the first step of the task (turning on the device by pushing the Home button). However, the target of the task was to independently complete Step 1 followed by Step 2 (pushing the Home button then unlocking the screen by sliding the arrow across the screen). On the third session of Acquisition Training, Steven's performance indicated skill acquisition, but only showed a consistently high succession rate on his sixth session of Acquisition Training. Sam's performance indicated that he gained a consistent level of acquisition on his seventh session of Acquisition Training.

Both participants showed 100% successful response of turning on the SGD during Follow-up. During 3 sessions of Follow-up, Steven had a mean of 34.33 successful sequences of requests for each 5 min sessions with no errors. Sam had 5 Follow-up sessions and overall made an average of 19.4 sequences of requests in 5 min sessions with no error attempts.

Statistical Analyses

Aside from the visual analysis of the slopes of the graph, statistical analyses were also applied in the present study to determine the statistical power of the results. An independent t-test was conducted on the means of the phases of the study and Cohen's d was also calculated to measure the effect size of the intervention. These procedures were considered crucial because effect size measurement is important in analyzing results of single-case designs (Kennedy, 2005). The distinction of effect size values follows Cohen and Cohen's (1983) discussion, where (a) effect sizes less than .3 reflects inefficacy of the intervention, (b) effect sizes between .3 and .8 reflect moderate efficacy of the intervention, and (c) effect sizes above .8 indicate a significant efficacy of the intervention. Descriptive statistics and analyses of the present study is presented in Table 1.

Steven and Sam's results were combined to measure the mean comparisons between the intervention phases. For Intervention 1, making 2-step sequence of request and navigating through the device, statistical analyses showed that although there was a significant difference between Acquisition Training and Baseline with $t(22)=7.55$ ($p<.05$), the intervention was only moderately affecting the initial condition ($r=.74$).

Table 1

Descriptive statistics and mean comparisons and effect sizes of phases of Interventions

Intervention Phases	N	M (SD)	*t*	*P*	Cohen's d	r
Intervention 1						
Baseline	12	.00 (.00)			-	-
Acquisition Training	23	14.43 (9.17)	7.55	.00*	2.19	.74
Intervention 2						
Baseline						
Turning on device	10	.50 (.00)	-	-	-	-
Requesting	8	22.87 (5.79)	-	-	-	-
Acquisition Training						
Turning on device	33	.69 (.39)	10.16	.00*	2.82	.82
Requesting	28	30.21 (8.19)	4.75	.00*	1.87	.67
Follow-up						
Turning on device	8	1.00 (0.00)	-	-	-.29	.33
Requesting	8	25.00 (10.81)	-1.36	.22*	-.62	.71

* two-tailed

For Intervention 2, results were measured by analyzing the effect on Acquisition Training with Baseline and Follow-up with Acquisition Training. Significant differences were statistically evident for turning on the device, $t(32)=10.16$ ($p<.05$) and the effect size showed that the Acquisition phase was highly effective, $r=.82$. However, for making a 2-step request and navigating the device in Intervention 2, although on average the results in Acquisition Training was significantly higher compared to Baseline, $t(27)=4.75$ ($p<.05$) but the magnitude of the intervention during this phase was only moderate ($r=.67$). There were no significant differences during the Follow-up phase compared to Acquisition Training, however, there was strong negative effect of the Follow-up on the Acquisition Training phase in requesting (Cohen's d=-.62, $r=.71$).

CHAPTER 5

DISCUSSION

Overall, the intervention strategies were moderately effective in teaching the participants the skills required to be able to independently turn on and unlock the device and also make a multi step requesting sequence using the iPod Touch® with the Proloquo2Go™ software as a communication aid. The intervention technique of using graduated guidance and time delay in one-to-one training sessions increased the participants' performance in making successful sequence of requests and activating the iPod Touch® independently.

The results of the present study provides empirical evidence demonstrating the success of applying instructional techniques in order to teach individuals with autism the skills required to be able to navigate through the pages on the iPod Touch® to request for preferred items. This is different from previous studies using this particular device as an SGD (Kagohara et al., in press; van der Meer et al., 2010), where participants were asked to make a single request without having to navigate through more than one screen. Considering the novelty of this specific SGD, it is crucial to provide empirical evidence to help clinicians and practitioners decide whether or not the iPod Touch® would be suitable to use as an SGD for individuals with developmental disabilities (Mirenda, 2009b; Sennot & Bowker, 2009). Although only presented by two cases, the positive outcomes of this research extends previous research involving teaching children with developmental disabilities the functional use of the iPod Touch® as a speech generating device to make a request of preferred item (Kagohara et al., in press; van der Meer et al., 2010). The present study is also consistent with previous research that suggested specific and systematic instructional strategies are significantly effective in teaching individuals with developmental disabilities to acquire new set of skills (Duker, Didden & Sigafoos, 2004; van der Meer et al., 2010).

Results from the Baseline of both Intervention 1 and 2 in the present study showed that both participants showed a consistently low success rate in performing the tasks. This indicates that although they have had previous experience in using the iPod Touch® as a communication aid to make a request for a preferred item (Kagohara et al., in press; van der Meer et al., 2010), they did not have the skills needed to independently turn on and navigate the device and make a multi step requesting sequence. Therefore they were eligible to participate in the next stage of the Interventions.

There are several important reasons for conducting the Baseline phase. First, it provides information of which item was more preferred by the participant. The preferred item(s) were noted as reinforcement for the next stages in the study. Second, it builds a good rapport between the participant and the observer. A good relationship is crucial when working with participants with autism and with their social impairment it takes them longer to get familiar with new people. Third, during baseline the observer can analyze the ability of the participant, in this case, to make a request. For example, if the student has already acquired the skills to request for a preferred item, most likely this skill appeared during baseline.

Observation data during Baseline for Intervention 1 revealed that during the 5-min sessions, both participants were often off task and frequently performed self-stimulating behaviour, such as kicking, flicking paper, producing unintelligible sounds, hitting their head, grabbing the observers' hand, jumping, gazing to their self-reflection in the mirror and biting hand. These traits were consistent with the symptoms of autism (Folstein, 2006; Kanner, 1971, 1973; Ozonoff, Goodlin-Jones & Solomon, 2007; Rutter, 1978; Wing & Gould, 1979). The 30 s fixed-time schedule of reinforcement was important during Baseline to maintain the participant's attendance in the study. Considering their problem behaviour due to their disability, it was needed to apply strategies to keep them on task and attending during the sessions. Sessions were also kept in a short period of time, allowing breaks between sessions. Aforementioned strategies were consistent with DTT intervention (Lovaas, 2003) and previously well-established strategies of teaching new skills for individuals with developmental disabilities (Duker, Didden, and Sigafoos, 2004).

Visual analysis of slopes of the graph for Acquisition Training phase for both Steven and Sam during Intervention 1 showed an increase in performing successful response compared to the baseline. This result was also supported by the statistical analyses, showing a significant difference ($t(22)=7.55$, $p<.05$) between the means of Acquisition Training and Baseline ($M=14.43$, $SD=9.17$; $M=.00$, $SD=.00$, respectively). Furthermore, analysis of the effect size of the Acquisition Training suggested a moderate level of magnitude of the intervention ($r=.74$).

The results of Acquisition Training for Intervention 2 also showed a significant increase in the performance of turning on the iPod ($t(32)=10.16$, $p<.05$) and making a 2-step request and navigating through the pages ($t(27)=4.75$, $p<.05$), with a moderate to high magnitude of the intervention ($r=.67$ to $.82$).

During Acquisition Training phase for Intervention 1 and 2, observation data revealed that such problem behaviour decreased when both participants achieved acquisition. However, during Acquisition Training for Intervention 1, there were instances when Steven was distracted (Session 10) and performed self-stimulating behaviour. His low performance in Session 11 of Acquisition Training Intervention 1 was due to the error of the primary observer's instructions by saying: "*Go back*", which made Steven raise and move away from his chair towards the other side of the room. The correct instruction should have been: "*Push the Back button*", which when used, had a positive impact on Steven's successful attempts. The tendency to interpret language literally is one of the symptoms of individuals with ASD, as a form of their impairment in interaction (APA, 2000). Therefore it is crucial to carefully choose the instructions to be given to these individuals. Instructions should be kept short and not ambiguous. Sam's decrease during the Acquisition Training phase of Intervention 1 (Session 15) was because he was distracted by the noise in the classroom. During Acquisition Training, Sam showed better performance when the noise was eliminated.

The trainers' observation during data collection also revealed that there were instances during Acquisition Training of Intervention 1 when both participants chose the toy icon on the first page which brought them to the second page, displaying three options of specific toys. However, before making the second request on the second page, they successfully returned to the first page by pushing the Back button and continued to make the sequenced request for snack. This indicates that they were able to discriminate the stimuli and independently correcting their choice of request which was not specifically taught during Acquisition Training.

The visual analysis of the graph and statistical analysis during Follow-up and Acquisition Training for Intervention 2 suggested there was not a significant difference in the frequency of the participants' performance of successfully turning on the device, unlocking the screen and making a multi-step requesting sequence independently ($t(7)=-1.36$, $p>.05$).

Implication and Application of Findings

The present study has several implications. First, the overall results of the present study suggested the procedures used in the intervention were effective in teaching adolescents with autism the skills to independently use the iPod Touch® to turn on and unlocking the device, make a multi-step requesting sequence. The procedures in this study involved response prompting, prompt fading, and differential reinforcement procedures, all of which are well-established techniques of teaching individuals with developmental disabilities (Duker, Didden & Sigafoos, 2004; Lovaas, 2003). This means that by generally incorporating these methods of teaching, there is a high chance of success in for individuals with autism to acquire new sets of skills. Second, the participants in the present study were adolescents with autism, yet they were able to acquire new skills in a relatively quick period. This means that the process of learning new skills for individuals with autism can still occur with a likelihood of success in the later age of life. Third, the present study also serves as one of the few empirical evidence of the successive use of the iPod Touch® and Proloquo2Go™ software as a communication aid for individuals with autism.

The implication of the present study is beneficial in applying several important conducts the field of special education, especially autism. Since the prevalence of children affected with ASD has rapidly raised worldwide, clinicians, professionals, educators, parents, caregivers are urgently required to find and apply evidence-based practices in the child's early intervention and individual educational programmes. This study has provided empirical evidence to the field of AAC and ASD of teaching adolescents with autism a functional way of communicating. The results of the present study will hopefully provide a useful contribution in making decisions of choosing successful methods of teaching children with ASD in various settings, whether in a classroom, homes or in the community. The decision of choosing a particular AAC system to meet the stakeholder's needs to be evidence-based and findings of this study will hopefully contribute in making such decision.

Limitations of the Present Study

The present study showed promising results in teaching adolescents with autism skills in using an SGD to activate and make a multi-step requesting sequence independently. Results of this study will hopefully contribute in providing evidence-based practice which can be a great benefit for individuals with language impairment, caregivers, clinicians and teachers should they choose to use of this new type of SGD as an AAC system since it has several competitive features compared to the previous SGDs. However, it should be noted that the small number of participants would be a limitation in applying the results in the field. Future research is still needed to explore the possibility in using the iPod Touch® and Proloquo2Go™ application as a communication aid for individuals with other types of developmental disability or age. Although the overall intervention procedures in the present study was suggested to be effective, more control needs to be applied to reduce noise in order to increase the efficacy of the intervention.

Future Research Directions

Individuals with ASD are usually visually oriented. The iPod Touch® has a lot of features that might be beneficial to the stakeholder in the ASD field since this device is mostly activated by simply touching the icons on its screen. More empirical research on this new type of SGD is needed to investigate the possibility of teaching children with ASD or other developmental disability various skills using this particular device, for example academic, social or leisure skills.

Conclusion

The present study provides empirical evidence of teaching adolescents with autism required skills to independently use this new type of SGD, specifically to activate and make a multi-step requesting sequence of preferred items. This study also supports previous findings on teaching individuals with autism to use an iPod®-based SGD as a communication aid (Kagohara et al., in press; van der Meer et al., 2010). Following backward chaining teaching method, with multiple-baseline single case study design, the participants in this study were taught how to independently activate the SGD, make a multi-step requesting sequence and navigate through the pages of the device. Results suggested that intervention adopting response prompting, prompt fading, and differential reinforcement procedures were effective in teaching sophisticated skills of operating the iPod® -based SGD.

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APPENDIX A

DATA SHEET

Sequence Baseline Data Sheet

Name: Observer: P/S
Date: Session:

1 only	1 + 2	2	Return to 1	Integrity Check
				1 2 3 4

Name: Observer: P/S
Date: Session:

1 only	1 + 2	2	Return to 1	Integrity Check
				1 2 3 4

Name: Observer: P/S
Date: Session:

1 only	1 + 2	2	Return to 1	Integrity Check
				1 2 3 4

Name: Observer: P/S
Date: Session:

1 only	1 + 2	2	Return to 1	Integrity Check
				1 2 3 4

Procedure:

1. Set up – iPod is placed in front of the participant, trays are visible but out of reach of participant.
2. Trainer ask: “Let me know if you want something”
3. Give participant access to the snack tray every 30 s
4. Replenish trays, start again with step 1 until the 5 min session is finished

Sequence Acquisition Training Data Sheet

Name: Observer: P/S
Date: Session:

Page 1	Back Button	Page 2	Back Button	Integrity Check
				1 2 3 4

Name: Observer: P/S
Date: Session:

Page 1	Back Button	Page 2	Back Button	Integrity Check
				1 2 3 4

Name: Observer: P/S
Date: Session:

Page 1	Back Button	Page 2	Back Button	Integrity Check
				1 2 3 4

Name: Observer: P/S
Date: Session:

Page 1	Back Button	Page 2	Back Button	Integrity Check
				1 2 3 4

Procedure:

1. Set up – iPod is placed in front of the participant, trays are visible but out of reach of participant.
2. Trainer ask: "Let me know if you want something"; if no response in 5 s prompt with verbal and/or gestural; if no response in 10 s prompt with physical guidance
3. Trainer ask: "What do you want to eat/play with?"; if no response in 5 s prompt with verbal and/or gestural; if no response in 10 s prompt with physical guidance
4. After 10 – 15 s trainer ask: "Let me know if you want something" if no response in 5 s prompt with verbal and/or gestural; if no response in 10 s prompt with physical guidance

Turning on iPod & Sequence Baseline Data Sheet

Name: Observer: P/S
Date: Session:

Home Button		Sliding Arrow		Integrity Check
				1 2 3 4
Page 1	Back Button	Page 2	Back Button	Integrity Check
				1 2 3 4

Name: Observer: P/S
Date: Session:

Home Button		Sliding Arrow		Integrity Check
				1 2 3 4
Page 1	Back Button	Page 2	Back Button	Integrity Check
				1 2 3 4

Name: Observer: P/S
Date: Session:

Home Button		Sliding Arrow		Integrity Check
				1 2 3 4
Page 1	Back Button	Page 2	Back Button	Integrity Check
				1 2 3 4

Procedure:
1. Set up – iPod is placed in front of the participant, trays are visible but out of reach of participant.
2. Trainer ask: “Turn on the iPod”, wait 30 s
3. If no response after 30 s, trainer will take away the iPod from the participant’s visibility and turn it on. iPod will be placed in front of the participant again, showing page 1 of the requesting task.
4. Continue with Acquisition Training Intervention 1

Turning on iPod & Sequence Acquisition Training Data Sheet

Name: Observer: P/S
Date: Session:

Home Button		Sliding Arrow		Integrity Check
				1 2 3 4
Page 1	Back Button	Page 2	Back Button	Integrity Check
				1 2 3 4

Name: Observer: P/S
Date: Session:

Home Button		Sliding Arrow		Integrity Check
				1 2 3 4
Page 1	Back Button	Page 2	Back Button	Integrity Check
				1 2 3 4

Name: Observer: P/S
Date: Session:

Home Button		Sliding Arrow		Integrity Check
				1 2 3 4
Page 1	Back Button	Page 2	Back Button	Integrity Check
				1 2 3 4

Procedure:
1. Set up – iPod is placed in front of the participant, trays are visible but out of reach of participant.
2. Trainer ask: “Turn on the iPod”. If no response in 5 s prompt with verbal and/or gestural; if no response in 10 s prompt with physical guidance
3. Trainer ask: “Unlock the screen”. If no response in 5 s prompt with verbal and/or gestural; if no response in 10 s prompt with physical guidance
4. Continue with Acquisition Training Intervention 1

Turning on iPod & Sequence Follow-up Data Sheet

Name: Observer: P/S
Date: Session:

Home Button		Sliding Arrow		Integrity Check
				1 2 3 4
Page 1	Back Button	Page 2	Back Button	Integrity Check
				1 2 3 4

Name: Observer: P/S
Date: Session:

Home Button		Sliding Arrow		Integrity Check
				1 2 3 4
Page 1	Back Button	Page 2	Back Button	Integrity Check
				1 2 3 4

Name: Observer: P/S
Date: Session:

Home Button		Sliding Arrow		Integrity Check
				1 2 3 4
Page 1	Back Button	Page 2	Back Button	Integrity Check
				1 2 3 4

Procedure:

1. Set up – iPod is placed in front of the participant, trays are visible but out of reach of participant.
2. Trainer ask: “Turn on the iPod” and “Unlock the screen”. If no response in 30 s trainer will take away the iPod from participant’s visibility and turn it on. iPod will be placed in front of the participant again, showing page 1 of the requesting task.
3. Trainer ask: “Let me know if you want something”
4. Trainer ask: “What do you want to eat/play with?”

Reliability Sheet

Study:
Student:
Phase:

Session	Inter-Observer Agreement (%)	Treatment Integrity (%)	Inter-Observer Agreement on Treatment Integrity (%)