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Using an iPad to teach spontaneous communication of students with low-functioning autism

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USING AN iPAD TO TEACH SPONTANEOUS COMMUNICATION OF STUDENTS WITH LOW-FUNCTIONING AUTISM

by

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Dedication

I would like to dedicate this work to my husband George and my incredible children:

Michael, Laura, Jessica and Valerie

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I would like to express my appreciation to Dr. Joy Xin for her patient guidance and encouragement throughout this research.

Abstract

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The purpose of this study is to examine the effects of using the Apple iPad to assist students with low functioning autism in learning communication skills. Three non-verbal students identified as having autism and being low-functioning participated in the study. A multiple baseline design with AB phases across academic and social settings was used. During the baseline, students were given access to an iPad with the SonoFlex voice output communication aid (VOCA) application. Some of the students played games on the iPad, but none of them attempted to us it for communication purposes. During the intervention, students were taught to use the iPad to communicate with their teacher and peers. With a least-to-most prompting hierarchy, all students increased initiating requests, responding to questions and making social comments.

Table of Contents

List of Figures

List of Tables

CHAPTER I

Introduction

Autism is a spectrum disorder (ASD) in a person's neural development which is characterized by a triad of symptoms: impairments in social interaction and communication, restricted interests, and repetitive behavior (Centers for Disease Control, 2012). Autism presents in a wide degree or spectrum, from those who are socially impaired and apparently cognitively disabled, to those whose symptoms are mild or improved enough to appear without a disability. Autistic individuals are often divided into those with an IQ >75 being referred to as having "high-functioning autism" (HFA), while those with an IQ <75 are referred to as having "low-functioning autism" (LFA). However, high and low-functioning are more commonly applied to how well an individual can accomplish tasks in his/her daily life, rather than to his/her IQ (Boucher, 2012). Usually, children identified as low-functioning have little or no language (National Research Council, 2001) which severely impacts their ability to meet daily needs. Differences in communication may be present from the first year of life, such as delayed onset of babbling, unusual gestures, diminished responsiveness, and vocal patterns that are not synchronized with the caregiver. In the second and third years, children with autism produce less frequent and diverse babbling, fewer words, and word combinations; and their gestures are less often integrated with words. These children are less likely to make requests or share experiences and are more likely to simply repeat others' words (echolalia). They also lack joint attention, the ability to coordinate attention between a person and an object, necessary for functional speech (Heflin & Alaimo, 2006).

Although adequate speech skills may not develop in a person with ASD, one should not assume that a person with low-functioning ASD is “too low-functioning” to develop spontaneous functional communication skills (Mirenda & Carson, 2000). Individuals with ASD at the low-functioning level have the potential to communicate their needs using an augmentative and alternative communication device (AAC) (Brittain, 2012). AAC refers to any tool, device, picture or gesture that compensates for expressive and receptive communication needs. Being able to engage in functional, spontaneous communication is a priority goal in educational programs for children with autism (National Research Council, 2001). Interventions that are recognized as best practice for both verbal language and alternate forms of functional communication should be consistently used in all natural settings and environments of children with autism (National Research Council, 2001). In order to achieve the desired goal of functional spontaneous communication for all students, the provision of AAC technology is mandated for students with significant communication needs (National Research Council, 2001) .

There are two systems of AAC: unaided and aided. The unaided system indicates manual signs, gestures, and vocalizations. This requires only body movement without any external objects or devices. Aided AAC are objects, such as three dimensional concrete items, pictures, photographs, words, or drawn symbols. The tangible, visible symbols of aided AAC can be used alone or paired with a voice output communication aid (VOCA), sometimes referred to as a speech generating device (SGD). This system delivers messages through “no-tech,” “low-tech,” or “high-tech” means. The no-tech includes simple tools without batteries or circuits, for example, a two-dimensional card with a word or communication symbol, a communication wallet with multiple communication boards, or an activity-specific communication board, such as *"Going bowling"* (Shane, Laubscher, Schlosser, Flynn, Sorce, & Abramson 2012). Using no-tech AAC, partners point to or exchange symbols during their communication. Low-tech devices include simple VOCAs capable of playing back recorded speech. High-tech devices are sophisticated VOCAs with the capability of generating hundreds of messages. The use of high-tech tools has increased communication options for individuals with ASD in new and unprecedented ways (Schlosser & Blischak, 2001). With the support of AAC, many of these individuals demonstrate a higher level of cognitive function then previously assumed by others (Cafiero, 2005).

Current new technology such as the Apple iPad, utilizing specialized AAC applications (apps), provides additional opportunities for those with ASD to meet their communication needs (Brittain, 2012). For example, many of the apps (e.g. *Proloquo2go, MyTalk, SonoFlex*) designed for these devices can serve as a full high-tech AAC system (Shane et al., 2012). The adoption of the new portable hardware and software provides a significant paradigm shift in AAC that is readily available to consumers in a small sized device, easy to transport, and at a relatively low cost (Mirenda, 2003). In addition, it avoids some of the barriers that historically have interfered with successful implementation of AAC in schools, such as the lack of technology skills in teachers and abandonment of AT tools by students (Marino, Sameshima, & Beecher, 2009). Traditional AAC devices often have been intimidating to teachers, leading to their reluctance to use them in the classroom. Technology training is time consuming and many school districts lack funding to provide adequate training or technical support to teachers to become skilled users (Marino et al., 2009). Comparatively, the new mobile devices are easy to use and many teachers are already familiar and comfortable with these devices outside of school. This technology experience in their own lives may motivate teachers to use these mobile devices in their classrooms.

Integrating technology is known to contribute to the educational success of students with and without disabilities (Crawford & Martin, 2004). The iPad is being used in typical classrooms to engage students in learning that enhances higher-level thinking skills and problem solving (Pilgrim, Bledsoe, & Reily, 2012). It is also a resource that supports special education by allowing teachers and students to access content and skill specific applications. For example, teachers can control settings to specific skills or ability levels and monitor student progress. Engaging apps make drills and practice more interesting for learners and the immediate, consistent feedback is beneficial for student learning (Pilgrim, Bledsoe, & Reily, 2012). According to Price (2011), the iPad and communication apps are superior to traditional AAC in the areas of durability, cost and appearance. One study found that students with ASD and cognitive disabilities who lack functional speech are able to communicate through the use of iPad based AAC devices (O'Reilly, 2011). Van der Meer and Rispoli (2010) and Rispoli, Franco, van der Meer, Lang, & Camargo (2010) reviewed studies that provided instruction and training to individuals with ASD and developmental disabilities, in using VOCAs for functional communication. Based on these two systematic reviews, there is support for the use of VOCAs for students with LFA.

Importance of the Study

To date, the use of the iPad has become popular and several AAC applications are now available. However, there is limited empirical evidence about these apps except for the *Proloquo2Go*; the results of which showed students with cognitive impairments could successfully make requests (van der Meer, et al., 2011), though there are numerous anecdotal reports of children with autism learning to communicate using this software app (Sennott & Bowker, 2009). More empirical studies on students with LFA being taught to use an iPad as a VOCA, are needed to evaluate the technology and software and find another avenue for meeting the communication needs of students with LFA. This would also enable teachers and speech-language pathologists to make evidence-based decisions when choosing an appropriate AAC device and software application for their students, as well as make an argument for funding to purchase the technology. This study attempts to expand research data of students with LFA using an iPad with an AAC application for communication.

Purpose Statement

The purpose of this action research is to determine the effect of an iPad, used as an AAC device, on spontaneous functional communication responses for students with low-functioning autism in the classroom. More specifically, this study aims to answer the following questions:

1. Will students with low-functioning autism increase their expressive communication, e.g. initiating requests, responding to questions and making social comments, in the classroom when utilizing an iPad?

2. Will instruction using an iPad, with a least-to-most prompting hierarchy, increase spontaneous (e.g. unprompted), communication of these students with their teacher and peers?

Chapter II

Review of the Literature

Students with developmental disabilities like autism, severe to profound cognitive disabilities or a combination of these disabilities frequently fail to develop speech and language skills (Bondy & Frost, 2002; Hetzroni, 2003; Sigafoos, 2004; Stephenson & Linfoot, 1995; Sturm & Clendon, 1995). Instead, they rely on behaviors such as pointing, reaching, eye gazing, and various facial expressions. Sometimes, these students may also present inappropriate behaviors such as aggression, tantrums, and self-injury to express their needs and wants (Durand, 1993; Durand, 2001; Frea, Arnold, & Wittinberga, 2001; Reichle & Wacker, 2010; Sigafoos, Drasgow, & Halle, 2004). In order to help these students advance beyond the pre-linguistic level of language or reduce the use of challenging behaviors for their communication, educators may need to use AAC strategies to support their language and communication development (Bondy & Frost, 2002; Sevcik, Romski, & Adamson, 2004).

Augmentative and Alternative Communication (AAC)

The most significant advance in AAC for students with low functioning autism (LFA) is the emergence of communication designed to help those who were believed to be cognitively incapable of expressing themselves (Mirenda, 2001; Schlosser & Blischak, 2001). AAC devices offer students with LFA a symbol/image, or set of symbols/images, which they can use to express appropriately their needs, wants and ideas after being taught to use the device. The common learning characteristics of students with autism should be considered when selecting AAC to support their communication efforts

(Miranda, 2001) although individual needs will ultimately determine the most appropriate device for each student. These characteristics include strong visual perception, unusual interest in inanimate objects, trouble processing complex cues, difficulty with changes, poor motor planning and small muscle movements, learning anxiety, and behavioral problems (Miranda, 2001). It was found that there appears to be a strong correspondence between the learning characteristics of students with LFA, and the features of AAC, which may make AAC a good fit when trying to meet the student's communication needs (Cafiero, 2005). According to Cafiero (2005), some of AAC features are designed to complement the characteristics of students with LFA. For example, AAC relies on visual presentations such as symbols, pictures, photos, and written words to communicate thoughts and ideas. The visual language on AAC devices is easier for non-verbal learners to understand than speech and manual signs (Mirenda & Schuler, 1988); thus maximizing the comparatively strong visual processing skills of students with LFA.

AAC tools and devices are inanimate, predictable, and more static than speech. These features motivate students with LFA who often dislike change and prefer consistency. Because these students often insist on "sameness", they may prefer the static and predictable grouping of symbols on a communication board. New concepts and associated vocabulary can be added to the board within the familiar framework of the existing symbols, which makes the learning process consistent and stable, with minimal disruption to a familiar routine. In addition, this creates reduced learning anxiety by creating a gradual introduction of new language as well as an easier way to accurately communicate his/her needs by simply touching or pointing to a symbol or image.

Motor planning refers to a student's ability to coordinate and sequence movements to accomplish a particular task, such as the oral-motor movements necessary for speech. Students with LFA have challenges with motor planning that may make it difficult for them to generate speech. Using an AAC device requires a simpler motor act, such as pointing to a symbol on a communication board or touching a button on a device. The touch screen on an iPad helps students express their needs or make comments requiring less complex motor planning than natural speech (Caferio, 2005).

Understanding and following the complex cues involved in speech, is difficult for students with LFA. To assist these students, AAC tools can be programmed with simple cues using one symbol, then using increasingly more cues with many symbols, as the student gradually learns to understand and express themselves using more complex language.

Behavioral difficulties of students with LFA are often the result of an inability to communicate. When a communication system is not provided for a non-verbal student, he/she may develop challenging behaviors, such as tantrums and being aggressive. AAC, when provided early, will preempt the need for the development of these difficult and sometimes dangerous behaviors. Introducing AAC to a student who has already developed inappropriate communicative behaviors can help decrease those behaviors by providing a simple, yet effective means of functional communication, eliminating the need and function of undesirable behaviors (Durand, 1993).

Voice Output Communication Aid (VOCA)

An AAC option for students with LFA can be a voice output communication aid (VOCA). A VOCA provides speech that is generated by touching/pressing an icon, which may be a symbol or image, on a communication device resulting in the audible expression of the icon selected.

Schepis, Reid, Behrmann, and Sutton (1998), studied the use of VOCAs by four young children with autism aged 3 to 5, who had little or no functional speech, and attended a special education classroom. These children were taught to use individual VOCAs with line drawing symbols to represent messages such as “I want a snack, please,” “more,” and “I need help.” Each message was represented by a single symbol on the VOCA displays. Naturalistic teaching procedures such as child-preferred stimuli, natural cues (e.g. expectant delays and questioning looks to elicit communication), and non-intrusive prompting techniques were used to teach the children to interact with classroom staff using their VOCAs. Over a 1-to 3-month period, all 4 children learned to make requests, respond to questions, and make social comments (e.g., "thank you”) during natural play and/or snack routines in the classroom. By the end of formal training, the majority of VOCA interactions by the children were spontaneous (i.e., unprompted) and contextually appropriate (Schepis, et al., 1998).

Similar findings were found in Mirenda, Wilk, & Carson’s study (2000) using VOCAs for older children ranging in age from 5 to 17 diagnosed as having an autism spectrum disorder (ASD). Of the 58 participating children, 41% had no functional speech, 50% had limited functional speech (i.e., 1 - 2 word utterances), and the remaining

9% had functional speech but at a level that was considered inadequate for their daily communication needs. Approximately 26% were estimated to have cognitive abilities in the average range, and the remainder had some degree of cognitive impairment. Their VOCAs included dedicated speech output devices (e.g. IntroTalkers) and laptop computers plus communication software packages (e.g., Macintosh computers with *Speaking Dynamically* software). Annual follow-up reports of the students' use of the VOCAs were analyzed and assigned "success scores" in three categories: little or no success, limited or some success, and successful or very successful. Results showed that only 8 of the 58 students had little or no success with their VOCAs, 31 students were rated as successful or very successful, and the remaining 19 students had limited or some success. The 31 students who were rated as successful or very successful represented all levels of cognitive ability. Although this research did not include a control group, to compare the learning outcomes, because removing access to communication techniques is unacceptable and unethical, the results provided no evidence of a relationship between cognitive ability and successful VOCA use. It is found that many students with autism and little or no functional speech can use VOCAs to successfully communicate (Mirenda, 2000).

The following four studies were procedurally similar and produced similar results. Sigafoos and Drasgow (2001) studied one student, 14 years old, with a moderate cognitive disability and autistic-like behavior. A VOCA microswitch with a picture representing "WANT" was connected to a verbal message of "I want more" and used to request and obtain any of several preferred food/drink and activity items. The student acquired successful requesting with the system.

Schlosser and Sigafoos, Luiselli, Angermeier, Harasymowyz, Schooley, & Belfiore's study (2007) included three students, 3 – 13 years old, with autism and severe cognitive disability and in one case, visual impairment. A VOCA microswitch with a picture representing "WANT" was connected to a verbal message of "I want more" and used to request and obtain any of several preferred food/drink and activity items. All students developed successful requesting with the system; two of them maintained it with or without the activation of the verbal recording; the student with the visual impairment had a decline in requesting under both conditions.

Sigafoos, Drasgow, & Halle (2004) studied two students, 16 and 20 years old, with a severe cognitive disability and autism or PDD. They were given a VOCA microswitch with a picture representing "WANT" connected to a verbal message of "I want more" and were taught to request and obtain any of several preferred food/drink and activity items. The students learned to use the system to make requests in substitution of pre-linguistic (i.e. pointing, grabbing) behaviors that were not successful. Additionally, the VOCA came to be used to initiate requests.

Another study by Sigafoos, O'Reilly, Seely-York, & Edrisinha (2004) included one student, 12 years old, with autism and a severe cognitive disability. A VOCA device with two pictures of preferred food/drink items or two pictures of preferred activities were used across multiple settings. This student was taught to press the pictures that produced specific verbal requests that were then satisfied. The student acquired successful requesting at a café, vending machine and home. In the instructional phase of each of these studies, discrete trial training procedures using preferred items, verbal cueing, such as "Let me know if you want something," time-delay, prompt fading and differential reinforcement were used. The results of these studies demonstrated that students with LFA can learn basic requesting skills using a VOCA. However, the research about VOCAs used by students with LFA is limited, especially considering the increasing rate of autism diagnosis (Hartley & Sikora, 2009). Additionally, possibly due to the low-incidence population of students with LFA, there are no large-scale randomized control trials, only single-subject design was used with small numbers of participants.

iPad/iPod as a Voice Output Communication Aid (VOCA) for Students with Low Functioning Autism (LFA)

Recently, there has been an increased use of mobile devices such as the iPhone, iPod and iPad Touch as VOCAs (Stuart, 2012). One particular VOCA application available on these devices is *Proloquo2Go* that includes over 8000 Symbolstix symbols. This program was applied in the field as AAC to teach students with cognitive impairments to make multiple step requests. For example, if the student selected “I want to eat,” he would then see a screen with the choices for “I want a cookie,” “I want a lolly-pop,” and “I want chips.” In Kagohara’s study (2012), two students, aged 13 and 17, were involved. The initial target response for each student was to request snacks and /or toys by selecting the corresponding icons from the VOCA. Teaching procedures included response prompting (verbally and then physically), prompt fading, and differential reinforcement. They were also taught how to turn on and navigate the iPod to find the correct program and screen pages. This skill was taught through a backward chaining approach with prompting and prompt fading interventions. These strategies were found to be effective in teaching multiple-step requesting to these students as well as effective functional use of an iPod. However, these findings should be interpreted with caution since the study involved only two students and both had previous experience in using an iPod to request preferred snacks and/or toys, although that experience was limited to learning a single-step requesting response not the multi-step sequence taught in this study.

In a study by van der Meer, Sutherland, O'Reilly, & Lancioni (2012), individuals with developmental disabilities were taught to use an iPod based communication device with the *Proloquo2Go* application to learn functional communication skills. Participants were three individuals with severe intellectual disabilities, two male adolescents aged 13 and 14 years and a 23-years-old female. They were selected based on related diagnoses, expressive language delays, and lack of prior exposure to VOCAs. A four-phase intervention sequence took place during the study consisting of a baseline, acquisition training, post-training and follow-up. Acquisition-training focused on teaching the participants to request snacks, toys, or social interaction (i.e., "I want a snack please." "Can I play with a toy?" "What's new with you?") by selecting graphic symbols on an iPod. The iPod was placed inside an iMainGo2 speaker case to increase sound amplification and configured to show a single page containing three graphic symbols representing preferred requests selected by their teacher. Graduated guidance, time delay, and differential reinforcement procedures were provided to teach the use of the iPod based system to the three participants. To do this, preferred snacks and/or toys were offered and the participants were prompted to select the corresponding icon, if an independent request did not occur within 10 seconds. Prompting consisted of physical guidance, which was faded using a 10- second time delay procedure. Following acquisition training, the two adolescent boys continued to make their targeted requests using the iPod and showed a steady rate of requesting at the 10-week follow-up. The results demonstrated that students with autism can effectively learn basic requesting with a VOCA. Although the findings were promising, the number of participants was small and focused on teaching only a beginning-level communication skill. The application selected reflects a limitation in the study. There are alternative applications available that can serve as AAC programs (e.g., SonoFlex, My Talk). Also, the third participant failed to show any progress over the course of 39 acquisition-training trials. On the 40^{th} and 2 more subsequent occasions, the third participant refused to accompany the trainer to the instruction table. This was taken as a lack of assent to participate and the student was excused from further participation in the study. The third student's lack of progress could indicate the need for modified procedures.

A study by Flores, Usgrove, Renner, Hinton, Stozier, & Hill (2012) investigated the use of an iPad as a communication device with the *Pick a Word* application installed as an AAC. Five elementary students aged 8 – 11 years old, with autism spectrum disorders and developmental disabilities, participated. They each spoke 10 or fewer words and communicated using a non-electronic picture system, and/or gestures, at home and in school. The students were given an iPad with six photograph icons of preferred food/drink items displayed, as well as an "I want" picture using the ASL sign for I WANT. Touching an icon produced a voice output corresponding to the picture selected. Each student received instruction regarding its use during snack time, which included explicit instruction, modeling the desired behavior, verbal prompting and physical prompting as necessary. The frequency of communication behaviors was compared under two conditions: a picture-based system and an iPad. Communication behaviors were not prompted. Food/drink items were made visible on a table and each student was given a turn to request an item. The students could respond with a picture, by touching the icon on the iPad, or not at all. The results were mixed. Three of the five students demonstrated more communication behaviors using the iPad. Two students stayed at the same frequency as when using the picture-based system. In addition, data were also collected using a questionnaire regarding the need for communication – both picture-based and iPad - as a VOCA. The staff also answered an open-ended question regarding their experience with the iPad. The instructors indicated a preference for the iPad citing reasons such as: ease of use, less time in preparation, fewer materials required for implementation, and students' increased speed in communication. Several students in the current study appeared to find the iPad appealing, and the teachers reported a preference. However, there were challenges associated with activating the selections on the iPad. The students needed to touch the iPad screen in a particular way in order to activate speech. Errors in activation were not counted against the students in this study, but this would be problematic in real life situations. These findings lend limited initial support to the iPad as a viable communication option.

Kagohara, van der Meer, Achmadi, Green, O'Reilly, Lancioni, & Sigafoos (2012) conducted a recent systematic review of studies that specifically involved iPods, iPads, iPhones and related devices, in educational programs for individuals with developmental disabilities. These studies reviewed were from 2008 to 2012, focusing on increasing academic, communication, social, and other adaptive behaviors in individuals with developmental disabilities and were summarized in terms of participants, target behaviors, procedures, and results. Eight of the 15 studies (e.g. Kagohara et al. 2011; van der Meer et al., 2011; Achmadi et al., 2012; Flores et al., 2012; van der Meer, Kagohara, et al., 2012; van der Meer, Didden, et al., 2012; van der Meer, Sutherland, O'Reilly, Lancioni, and Sigafoos, 2012), focused on teaching communication skills using the iPod Touch or iPad as VOCAs for enabling nonverbal individuals to communicate. The results of these studies were positive suggesting the iPods, iPads and related devices in educational programs for individuals with developmental disabilities are viable technological aids and appear to have some potential advantages over other types of assistive technology. Specifically, they are readily available, relatively inexpensive, and appear to be intuitive to operate. These devices also seem to be socially accepted and less stigmatizing when used as AAC by individuals with developmental disabilities. Anecdotally, the participants in these studies largely appeared to enjoy using the devices and in some cases seemed to prefer using them over low-tech options (Kagohara, van der Meer et al., 2012, van der Merr, Sutherland, et al., 2012). However, the communicative functions targeted in these studies were limited to naming pictures or requesting access to preferred stimuli. Use of these devices for other communicative purposes such as greeting, or commenting, are suggested as an important direction for future research.

While the studies seem to show that using VOCAs for students with LFA can be considered as an effective intervention, there are some challenges for teachers and therapists to consider. These include determining the most appropriate type of VOCA for specific students, the appropriate instructional procedures, whether more advanced communication skills can be learned and the effectiveness of generalization of learned skills to other settings such as the home and community. The enthusiasm and social acceptance of the most recent technology to enter the arena of AAC is the iPad Touch; this new tool does not necessarily equal student success and the challenges associated with using an iPad for functional spontaneous communication need to be considered in light of empirical research data. Reviewing the previous studies, only a few focusing on a relatively small number of students with LFA have provided conclusive evidence of the iPad being used as an effective means of developing functional spontaneous communication skills for these students.

Finally, selection of an appropriate communication application (app) for the iPad must also be considered. The choice must be student-centered and matched to student's individual educational goals for communication. Wehmeyer, Smith, Palmer, and Davies (2004) identified desirable software and app features: simplified screens and instructions; consistent placement of menus; graphics along with text to support nonreaders and early readers; audio (voice) output; and easy error correction. Additionally, the Rehabilitation Engineering Research Center on Communication Enhancement (AAC-RERC) recommends consideration also be given to the core vocabulary set and its organization, the size of the symbol set, the ability to add additional pictures / symbols as needed, programming ease and the ability to support the development of language skills. Research which is student-focused and gathers evidence about communication effectiveness in real environments will provide vital information about how specific applications can result in successful communication.

Summary

Although there is a significant amount of research on providing and using AAC/VOCAs for students with LFA, there is a great need for additional studies on using the new technology, such as the iPad and similar tablet devices. The studies reviewed here were focused mainly on basic requesting, which is a beginning language skill. Communication skills including responding to others and making social comments (i.e. greetings and expression of feelings), were not addressed.

To date, there are many communication applications available, to be used on the iPad and similar mobile devices allowing them to function as an AAC device. Research on the iPad / iPod as an AAC, has studied only the application *Proloquo2Go* except one study that used *Pick a Word.* More studies are needed in the future. Autism presents different challenges for each individual and therefore not only the device, but also the application must necessarily be individually considered and selected based on the specific needs of each student.

Functional spontaneous communication during daily tasks should be the measure of a successful AAC intervention. To that end, additional studies on expressive language skill acquisition using an iPad and its applications are needed to verify previous findings and add information to the learning outcomes of students with LFA, as an effective communication aid.

Chapter III

Methods

Participants

Three 10-year-old students, one female and two males, diagnosed with Autism Spectrum Disorder (ASD) and a moderate cognitive disability participated in this study. They were chosen for this study because they have low-functioning autism; they rely primarily on pre-linguistic behaviors such as reaching, leading, and physical aggression to communicate with others in class and they had no experience using an iPad as a VOCA. Prior to the intervention, the students were prompted to request by pointing to Symbolstix picture icons located throughout the classroom, such as food/drink items (located on their placemats), break time and bathroom (located on their desks) and then they are given access to the item. Also there were picture icons of "yes" and "no" on their school desks to allow them to respond to yes/no questions. In the classroom, these students displayed early functional receptive language skills, such as one-step direct instructions (i.e. "Sit down," "Get out your book," "Line up.") with minimal prompting.

The Vineland Adaptive Behavior Scales (2nd Edition) and Wechsler Intelligence Scale for Children (4th Edition) were administered for all three participants in 2010 and the testing information is presented in Table 3.1.

Table 3.1

Testing Information

Student	I.Q.*	Expressive Language**	Receptive Language**
Student 1 **Samantha**	Unable to complete sufficient number of subtests to derive a score.	< 2 years	55 which is considered "Low" (higher than 1% of her peers)
Student 2 **Eric**	Unable to complete sufficient number of subtests to derive a score.	Non-verbal	No score due to interfering behaviors during testing attempts.
Student 3 **Christian**	Unable to complete sufficient number of subtests to derive a score.	Non-verbal	No score. Records indicate he pointed to all responses for each question.

*Wechsler Intelligence Scale for Children (4th Edition)

**Vineland Adaptive Behavior Scales (2^{nd}) Edition

All three students had limited social skills, They preferred to be alone, and often ignored peers but accepted attention from the adults in the classroom.

Student 1, Samantha, scripted a few spoken words in a frantic sounding fashion (e.g., "swing", "good girl", "break please", "No, thank-you") when she was asked to do something, but rarely spoke unless prompted to do so by an adult. She was able to repeat a word that was modeled for her in response to a question. Samantha became easily frustrated and aggressive towards the adults assisting her. She engaged in self-injurious behaviors such as hair pulling and poking her eyes. She was learning to use a calm-down app on her iPad, when she begins to show signs of agitation. She enjoyed receiving firm, squeezing pressure on her hands and arms.

Student 2, Eric, attempted to communicate by leading an adult towards what he wanted. He did not speak any words, but yelled and bit the palm of his hand when frustrated. According to his parents, he was accustomed to getting what he wanted at home and very few demands were placed on him. At school, when Eric was given a task, for example, being asked to respond to a question in a lesson, or to do a classroom job, he engaged in self-injurious behavior by hitting himself in the face with enough force and frequency to bloody his mouth. He would often hit adults in frustration or to gain their attention.

Student 3, Christian, was usually very quiet and compliant. If he felt unsure of expectations or pressure to communicate, he engaged in hand flapping and a single loud scream. He did say, "Thank-you" and "Bye" one time at school with perfect pronunciation. He did seem to try and say words occasionally by opening his mouth with intention, but no words are uttered. When he was given a choice of items or pictures to choose from he repeatedly pointed to each item in turn. If he was given an undesirable item he looked at it and waited for something else to happen. Occasionally he would burst into tears, apparently due to an un-communicated need, such as wanting to eat, needing the bathroom or wanting play with something he sees.

Each of the students had an individual education plan (IEP) in which the goals of learning to use a VOCA to communicate basic needs/wants, responding to questions and making appropriate social comments were addressed.

Setting

Samantha, Eric and Christian attend their local public elementary school with 1,500 students. They are in the building housing grades 4-6 with 600 students. The school is located in a suburban township, with a population of 15,000. The racial makeup of the township is 96% White, 2% African American, 1% Hispanic and 1% other races. The family median income indicates this is a middle class community.

The study was conducted in a self-contained classroom for students with multiple disabilities in a newly established program. The program provides state-mandated academics with an instructional emphasis on effective communication, independent living skills and behavioral support. The students have a shortened school day, attending from 8:45 to 2:15. They have an in-class breakfast provided each morning as part of their instructional program. The students eat lunch in the school cafeteria with their grade-level peers. In addition to the three participants in this study, there are two other students in the classroom with multiple disabilities. Each student has their own aide to assist with communication, academic instruction, behavior, and personal needs. There is one special education teacher with 20+ years of teaching experience. The teacher conducted this study. Prior to this school year, the students were in an out-of-district placement, attending a school for students with significant disabilities.

Instructional Materials

Each student was provided with an Apple iPad, housed in a protective cover with carrying handles and a screen shield. Applications (Apps) were downloaded onto the iPad that the students could use for their leisure such as story books, coloring pages, music and games, as well as educational apps and behavior support apps, such as a timer, a calm-down counter, and first-then charts. The students' iPads were personalized with photos of themselves on the opening screen page and will continue to be individualized with additional apps that they seem to prefer. In addition, Sonoflex , a voice output communication aid (VOCA) was downloaded onto their iPads. The Sonoflex icon was placed in the lower right-hand corner of the iPad opening screen page for consistent ease of access. By tapping on the icon, the Sonoflex screen page opens and displays category buttons, called "contexts", that when touched, open to vocabulary screens that are programmed with appropriate Symbolstix picture icons, or photographs taken with the iPad (See Appendix A as an example). When the student selects an icon, by touching a button on the screen, computer generated speech for that icon is produced using a gender/age appropriate (woman, girl, man or boy) voice. A single word or a complete sentence may be programmed on each button. For example, when the numeral 4 is touched the iPad speaks: "four", when the icon with snacks is touched, the sentence: "I want a snack, please." is spoken. On the home page of the Sonoflex app, the following context buttons were created by the teacher: "Morning Meeting", "Math", "Reading", "Social Studies", "I want" and "Being Friendly". If a special activity or event is scheduled (e.g. a class trip to the bowling lanes), an additional context button is added along with the appropriate vocabulary in that environment. (See Appendix B for an example of vocabulary words presented on each context screen).

Measurement Materials

Figure 1 presents the coding sheet created to record student communication opportunities and the prompting level required to support the student to make a communication response using his/her iPad. Each communication opportunity for the student was tallied as a request, response, or social comment.

Observation Checklist:	*Baseline*	*Intervention*
	(Circle one)	

Student: Observer:	Date: Session :

	Setting	Minutes:										Weighted Prompting %**
Request *(ie: I want….., I need a break, I need to use the bathroom)*		Opportunity (check mark)										
		Prompt Score*										
		Opportunity										
		Prompt Score										
Response *(single word or phrase answer to a question posed by an adult or peer)*		Opportunity (check mark)										
		Prompt Score*										
		Opportunity										
		Prompt Score										
Social Comment *(ie: Hi, Bye, I like it, Thank you, Excuse me, It's your turn, I'm finished)*		Opportunity (tally mark)										
		Prompt Score*										
		Opportunity										
		Prompt Score										

**Prompting Score: (5) Independent (4) Verbal (3) Gesture (2) Model (1) Physical (0) Non-Communicative*

** Sum of prompting scores / Total # of communication opportunities X 5 (independent) X 100 = weighted prompting score

Figure 1 Coding Sheet

The three types of communication opportunities recorded were requests, responses, and social comments. Table 3.2 presents some examples.

Table 3.2

Examples of Communication Types

Type of Communication	Examples
Request	"I want cereal."
	"I want a break."
	"I want to use the bathroom."
Response	*What is your name?* "Eric"
	What is the weather? "Sunny"
	Where did we go today? "Bowling"
Social Comment	"I like it!"
	"I am sorry."
	"It's your turn."

A prompt score was assigned to indicate the level of support required to assist the student in using the iPad to communicate with an individual. Table 3.3 presents the prompt scores.

Table 3.3

Prompt level and associated scores

Prompt	Independent	Verbal	Gesture	Model	Physical	Non-Communicative*
Score	5	4	3	2	1	0

*Student was not attentive to instruction and/or showed unwillingness to communicate with the iPad

Instructional Procedures

Two weeks prior to this study, the students were presented with their iPads and taught to turn on, access and use some simple leisure-time applications such as story books, music, relaxing sounds/patterns and coloring. The instruction consisted of faded physical prompting and natural reinforcement (e.g., the student using the application). Prompts were provided using a least to most prompting hierarchy (see Table 3.4) paired with a 5-second pause after each communication opportunity that was presented. If a student did not respond within the 5-second pause, a higher level prompt was given with another 5-second pause. This pattern continued until a successful communication exchange was achieved. The prompting score was determined by the final level of prompt required to elicit an appropriate communication from the student. All non-physically prompted student communications were immediately recognized for their communication attempt and rewarded with social praise. If it was a request, access to the requested item was granted. A correct response to a question received additional praise for being correct. If the answer was incorrect, the question was restated or rephrased, the correct answer indicated on their iPad, and the student was given another opportunity to respond by touching the correct button. A prompting cue of sufficient strength was given to secure a correct response, and a verbal praise, “Good answering!” was provided. For an appropriate social comment made by the student, a natural, positive social response was enthusiastically given. For scoring purposes, if the same cue (communication opportunity) was immediately presented again, as an additional practice opportunity, only the initial communication attempt was tallied and scored.

Table 3.4

Least-to-Most Prompting Hierarchy

Level of Prompt	Example
Independent	The student initiates a communication without any help. This is considered a non-prompted communication.
Verbal	The student is given verbal directives such as, “Choose a button.” or, “Do you want ‘x’ or ‘y’?” or, “Tell Samantha it’s your turn.”
Gesture	Pointing to the specific area that the student should be looking at to make a communication attempt.
Model	Select the correct button and then give the students the opportunity to select the button by themselves.
Physical	Using a hand-over-hand process, guide the student to make the correct communication. Provide an opportunity for the students to make the selection by themselves.

The students were instructed to carry their iPads with them whenever they left the classroom to encourage generalization of communication skills across settings.

Measurement Procedures

The instructional method of fading prompt support to achieve independence required the data to reflect (1) attempts at communication and (2) the trend indicating progress of independent communication (e.g., decreased prompt support). Therefore, the data were calculated using a formula (sum of prompting scores/total number of communication opportunities X 5 X 100) that produced a “weighted” percentage. This calculation reflected the number of opportunities the student could have used the iPad as a VOCA during the course of a session, combined with prompting points based on the final level of support required to obtain an appropriate communication. By using this weighted percentage, a student who maintained the same number of communication attempts would be awarded a proportionally higher score if the communications were achieved at higher level of independence. This weighted percentage was calculated for each type of communication (i.e., request, response, or social comment) recorded.

Research Design

A research design with A-B phases was used in the study. During phase A, baseline data was collected during two, ten-minute sessions two days per week for two weeks. The sessions included one academic lesson (Language Arts) and one recess-time, such as after lunch, to provide opportunities for social comments and requests. During this phase, a session began when an academic lesson started or when the participant was dismissed for a break time. The student was verbally instructed, “Get your iPad and turn on SonoFlex.” The student was provided with prompts as needed. After successfully accessing the SonoFlex app, they were instructed to select the specific context button for that situation. The iPad was positioned lying flat, on the right side of their desk (all students were right-handed). No additional support or suggestion to use the iPad was given. If it was an academic session, the teacher presented the scheduled lesson for that day, and data were collected recording each of the teacher’s questions as a response communication opportunity and all student responses were recorded without providing any prompt support. A minimum of 5 questions were presented. If the student responded, initiated a request or made a social comment using the iPad, it was scored 5, as an independent communication. If the iPad was not used to respond, the opportunity was scored 0. If it was recess for the student, the iPad was placed in the area (usually within 5 feet) where they were taking their break. If they left the area, no reminders to take the iPad with them were given. Due to the non-verbal nature of the other students, an adult interacted with the student a minimum of three times, providing clear opportunity for the student to respond socially. Data were recorded for all opportunities to respond and any independent responses, requests or social comments using the iPad were scored.

Phase B, the intervention, data were collected during two, ten-minute sessions two days per week for 6 weeks. The sessions continued to be one academic and one recess-time. Instruction was provided using the least-to-most prompting hierarchy after a 5-second pause at each communication opportunity afforded. For example, during a Language Arts lesson, the teacher asked, “Samantha, which word starts the same as ‘car’?” The teacher waited for her response, by expectantly looking at her for 5-seconds. If no response was given, her aide verbally directed Samantha, “Answer with your iPad.” Again, a 5-second pause was provided. If there was still no response, the question was asked again, with the same tone of voice. If no response was given within 5-seconds, the aide pointed to the correct iPad button, providing a gesture prompt. If, after a 5-second pause there was no response, the question was re-asked. The aide then provided a model prompt by touching the correct button and then gave the student the opportunity to select the button by herself, within 5 seconds. Should Samantha still not respond, the question was asked again (still using the same tone as the first time) and the aide immediately guided Samantha, using hand-over-hand, to touch the correct button on her iPad. Samantha was then given an opportunity to touch the button by herself, if she wanted to, by saying, “Good touching the button to answer; now you try.” If she chose to touch the button on her own, she was given social praise and some hand squeezes. If she did not, the lesson continued without further comment on the question or response. The process was repeated for each of the communication opportunities provided. During a recess session, a social opportunity was provided by starting a game and then saying, "Whose turn is it?" or, after doing a puzzle together, prompting the social comment, "That was fun."

Reliability

For all sessions, the participant and teacher were present and one or two additional observers/data collectors were nearby. The recording scores were checked with at least two observers, the teacher and a teacher's assistant.

Social Validity

The teacher and a teaching assistant responded to three open-end questions:

1. What do you feel were the students' overall response to using the iPad in school?
2. In addition to being used as a VOCA, was the iPad helpful to the students or teacher in other ways?
3. How did typical peers respond to these students having an iPad?

Data Analysis

A visual graph of student responses was displayed to compare the difference between phases A and B in order to evaluate student performance.

Chapter IV

Findings

Each participating student's weighted prompting scores for requests, responses and comments were calculated by using the formula: sum of the prompt scores divided by the total number of communication opportunities during the session multiplied by 5 (independent) X 100 to convert to a percentage. Table 4 presents the means and standard deviations across phases A and B.

Table 4

Means and Standard Deviations of Student Scores for Requests, Responses, and Social Comments across Phase A and B.

Student	**Phase A**		**Phase B**	
	Mean	***SD***	***Mean***	***SD***
Eric				
Requests	0	0	41.81	20.88
Responses	0	0	45	14.54
Comments	0	0	44.19	15.25
Christian				
Requests	0	0	56.36	29.41
Responses	0	0	72.95	19.70
Comments	0	0	65.04	12.36
Samantha				
Requests	0	0	69.16	13.11
Responses	0	0	75.54	11.87
Comments	0	0	65.27	9.45

Requests

Results show that Eric, student 1, made 12 requests (nine requests in the academic and three in the social sessions) with a mean score of 42% during Phase B (See Table 4).

This indicates that Eric relied mostly on receiving a model prompt to initiate a request communication. Most of his prompted requests during the academic sessions were, “I need a break, please.” His prompted requests during the social setting were, “I need a piece (a puzzle piece)”, and “Can I have a drink (of water)? His initial instruction required physical prompts and he appeared uninterested or unmotivated, possibly due to sickness, during his last two sessions in the academic and social settings, which necessitated a return to physical prompting. Appropriately, a request that he was physically assisted to make at the end of the last social session was, “I need to go to the nurse.” During the academic setting, Session 12, Eric made his only verbally prompted request, “Tell me what you want,” when he was observed becoming agitated. Eric looked at his iPad, scanned the picture icons, and deliberately touched the button requesting a break.

Christian, student 2, made 11 requests (6 in the social and 5 in the academic sessions) during Phase B with a mean score of 56%. After the initial intervention sessions that required physical prompts, Christian relied mostly on verbal prompts. During the social setting he was verbally prompted with, “Tell me what you want to do,” and he would request, “I want to listen to music (or play with the frog), please.” In the academic session, Christian’s verbally prompted requests were mostly, “I need a break, please,” or “I need a pencil.”

Samantha, student 3, made 12 requests (6 in the social and 5 in the academic sessions) during Phase B with a mean score of 69% during the intervention. She never required physical prompting during the intervention phase, but mostly relied on gesture and verbal prompts. Frequently, a prompted request during academic sessions was, “I need a break, please." During the social setting, when it was perceived that Samantha needed a change in activities, she was verbally prompted to request a different activity and she often chose, "I want to play with my iPad, please." Figure 4.1 presents individual student's scores of requests in academic and social settings across baseline and intervention phases.

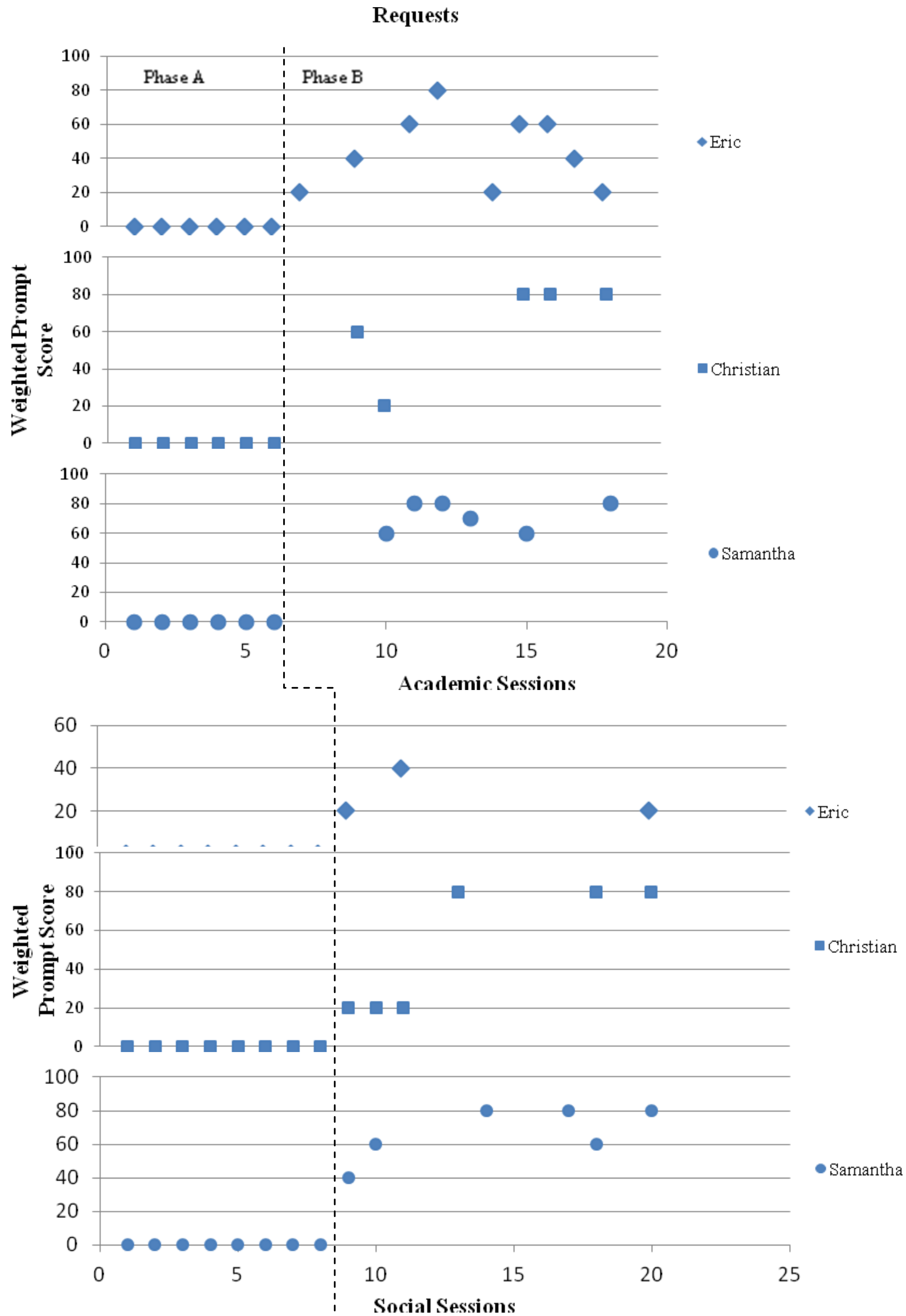

Figure 4.1 Weighted prompting scores of each student's use of the iPad to make requests during academic and social settings.

Responses

Figure 4.2 presents individual student's responses across Phase A and B. Eric responded to 85 questions during the intervention phase with a mean weighted prompting score of 45% (See Table 4), indicating that Eric was able to make most responses with model and gesture prompts. He only required physical prompting during his first intervention session in both settings and again in the last week of sessions when was unable to be attentive to instruction due to sickness. Eric often seemed to begin to focus on the iPad after a verbal prompt, but never selected a response until his field of options was narrowed down by a gesture prompt or a model prompt indicating to him what his response could be. Most of his responses in the academic setting were to "wh" questions based on the story being studied, such as "Who is building a snowman?" or "What is the girl doing?" Most of his responses in the social setting were to questions such as "What do you want to play?", "Whose turn is it?" or "Did you have fun?"

Christian responded to 81 questions during the intervention phase with a mean score of 73% (See Table 4) indicating that he quickly reduced his need for higher levels of prompting. Beginning with the 9th academic session he was able to independently respond to some questions. Christian responded to "Who?" and "What?" questions in the academic setting and in the social setting he responded to questions such as "What do you want to play?" and "Whose turn is it?"

Samantha responded to 63 questions during the intervention phase with a mean score of 76% (See Table 4) indicating a rapid reduction in prompting support. Samantha began giving some independent responses during the 10th academic session. Her verbal prompts were mostly, “Use you iPad to tell the teacher (repeat the question),” during the academic sessions. Upon beginning the social sessions, Samantha was asked “What would you like to do?” and she would often make a choice by activating a button that said, “I want to look at a book,” or “I want to do a puzzle.” During a game, her aide would often ask Samantha, “Whose turn is it?” and she would be prompted to respond, “It is your turn,” or “It is my turn.”

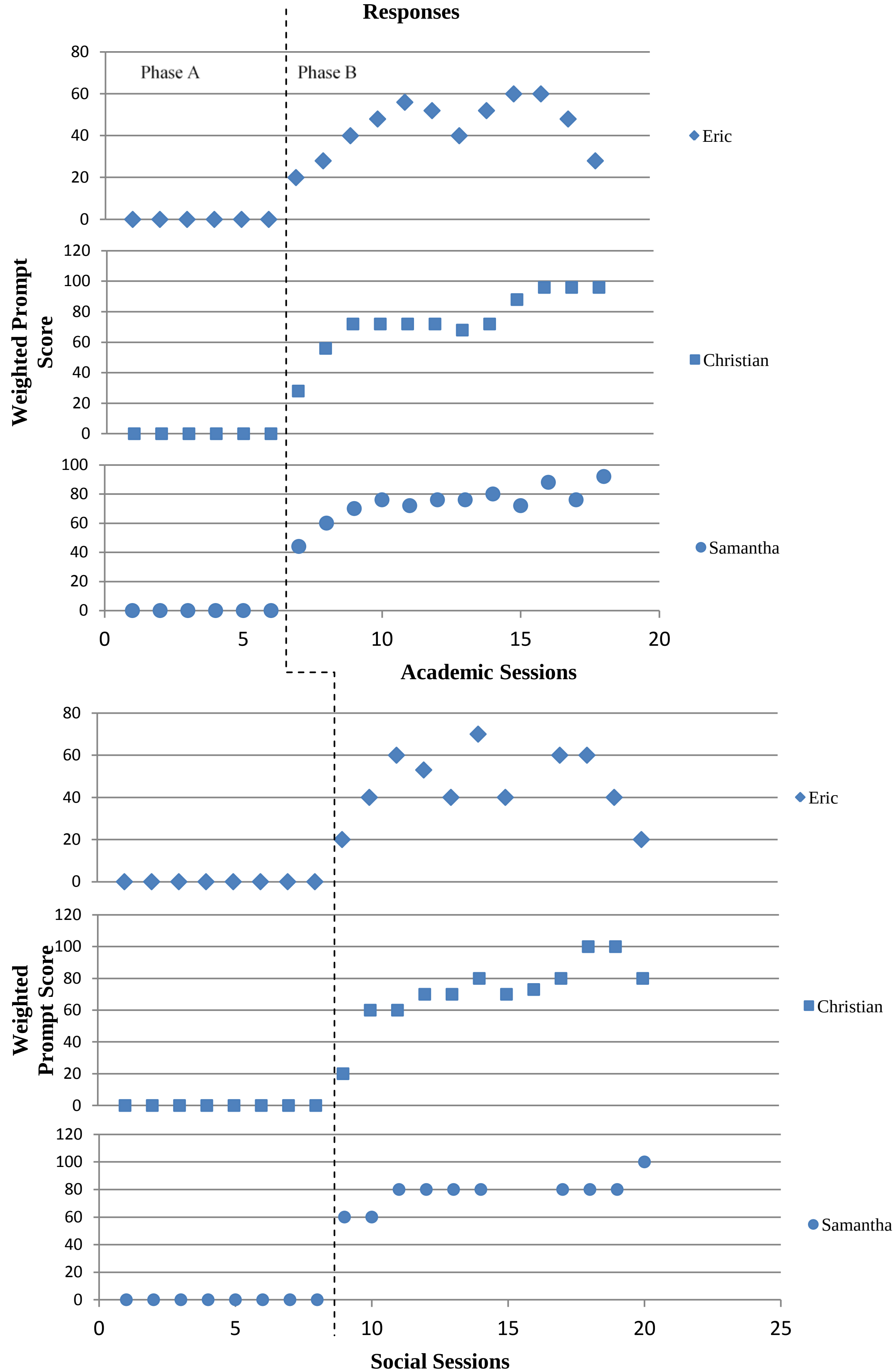

Figure 4.1 Weighted prompting scores of each student's use of the iPad to respond during academic and social settings.

Social Comments

Figure 4.3 presents the participating student's social comments during phase A and B. Eric made 66 comments during the intervention phase with a mean score of 44% (See Table 4), similar to the results of his responses. He quickly learned to make social comments with either model or gesture prompts. Eric would begin each session requiring higher level prompts and gradually make comments with a less intrusive prompt as the session continued. He showed progress over the course of the intervention, although possibly due to sickness, his last week of sessions showed that he needed increased physical prompts. Eric was prompted to end most academic sessions with the social comment, "I am finished," and most social sessions with the comment, "That was fun."

Christian made 68 social comments during the intervention phase with a mean score of 65% (See Table 4) indicating a consistent reduction of prompting support. Social comments were nominal during the academic setting, but during the social setting, Christian was prompted to make comments such as, "It's your turn," "I like that," or "I won!"

Samantha made 69 social comments during the intervention with a mean score of 65% (See Table 4). She ended each session with the comment, "I am finished." During the social setting, Samantha was prompted to comment on whose turn it was during a game, and whether or not she was having fun. She required verbal prompts throughout the intervention in both settings.

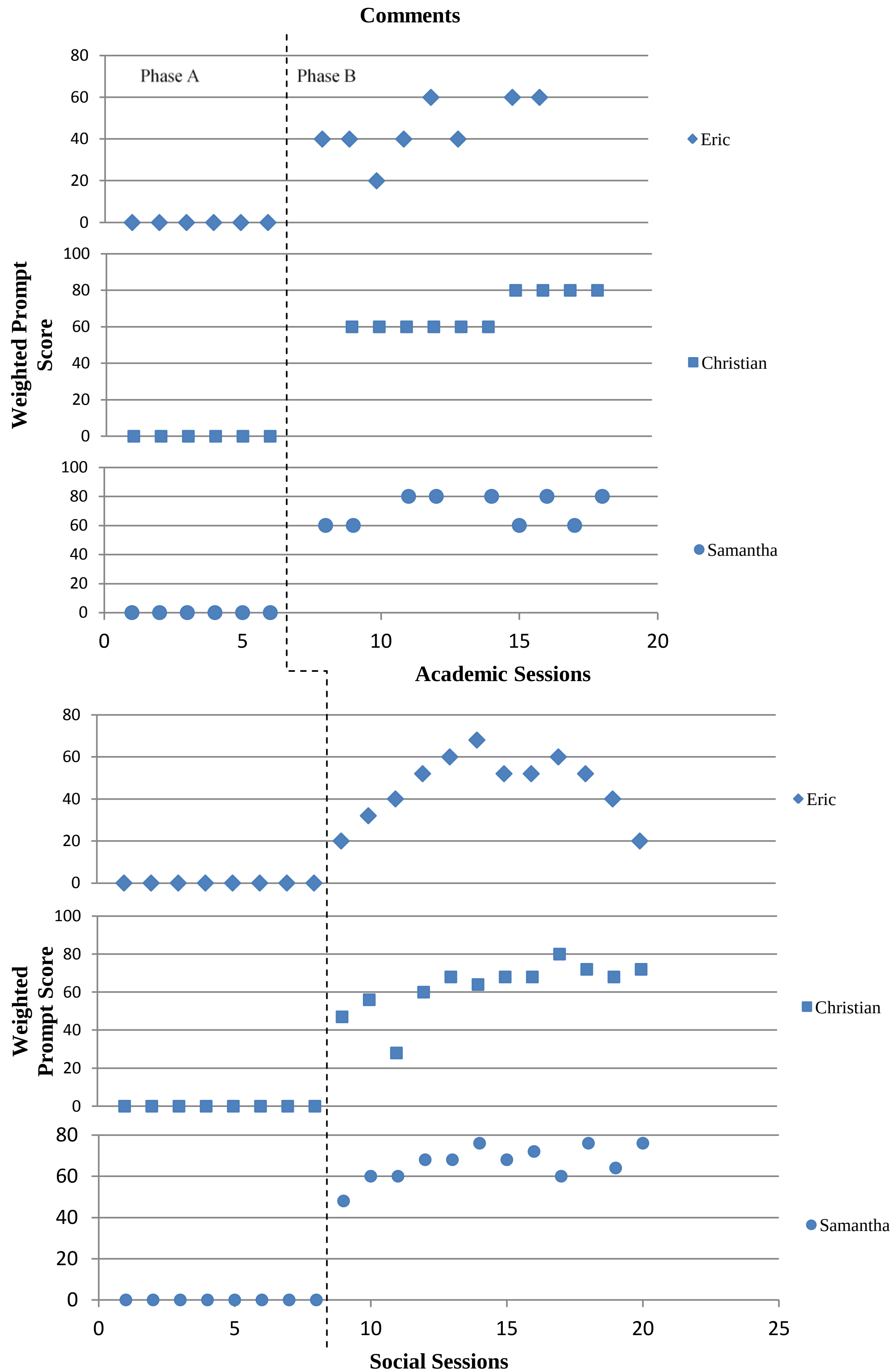

Figure 4.1 Weighted prompting scores of each student's use of the iPad to make comments during academic and social settings.

Social Validity

The teacher and an aide responded to three open-end questions. Their responses are shown below:

1. What do you feel was the students' overall response to using the iPad in school?

   Both of them stated that they saw a positive response from the students, stating the fact that they willingly took the ipads with them and that they chose to use the iPads during breaks, frequently exploring the SonoFlex app on their own.

2. In addition to being used as a VOCA, was the iPad helpful to the students or teacher in other ways?

   Both of them said they found it very convenient to have multiple tools at their disposal, especially a visual timer app, and apps specifically selected for each student that they could use and enjoy during breaks. The iPad camera allowed quick access for the recording of events, people and objects for future reference.

3. How did typical peers respond to these students having an iPad?

   Both of them observed positive reactions of typical peers when they saw these students carrying or using their iPads. The teacher stated that it was good to see other students pointing at the iPads and remarking on how lucky or cool it was that these students had their own iPads.

Chapter V

Discussion

An iPad creates new opportunities and possibilities for communication for non-verbal students with low-functioning autism. Parents, teachers and speech/language pathologists are eager to know if there is a solid basis for considering the iPad as an AAC device for these students to increase their expressive communication in the classroom, at home and in the community. Potentially, this would enable such students to respond to questions, initiate requests and make social comments throughout a school day. This study attempted to collect data in Language Arts classes (academic) and recess times (social) in school to measure the expressive communication of students with autism who were using an iPad, with the SonoFlex app, and the level of prompting necessary to increase student requests, responses to questions and social comments.

During the baseline, none of the three students were able to express themselves by using the iPads. In both academic and social settings, despite the availability and easy access, no student attempted to use the iPad for communication. For example, during Language Arts lessons, the teacher asked yes/no questions, which was the question format the students were accustomed to answering. Samantha and Christian occasionally responded, without prompting, by using the yes/no picture icons on their desks. They did not appear to notice or want to use the yes/no buttons on the iPad. Additionally, “Who”, “What” and “Where” questions were asked during Language Arts lessons, with the teacher supplying the answer after a 5-second pause. On the last session of the baseline, Eric appeared to “discover” the buttons on SonoFlex app and began touching them randomly, activating many of them in rapid succession. After allowing him explore the buttons for about three minutes, the teacher asked Eric to use his "quiet hands" until she asked him a question or he needed something (i.e., a break or the bathroom). He complied for the rest of the session.

Data collected during the students' recess time in Phase A, also indicated that the students did not utilize the communication capabilities of the iPad. They played as usual, making no attempt to use the iPad to request a specific game or toy, or make comments, such as, "It's your turn.", "I won!" or "I am finished." They did not use it to request a drink or snack. Eric was the only student who, again on the last session of the baseline, picked up his iPad and began to touch random buttons, in rapid succession, on the open Sonoflex. He appeared very focused about and interested in the iPad, but not as a means of communication. The teacher expressed concern that Eric was exhibiting self-stimulatory behavior with the device.

During the intervention phase, all three participants were receptive to instruction during the academic and social setting. The data collected during the intervention evidenced their improvement in communication skills. There was an increase of independence (reduced prompts) to make requests, responses and comments in academic and social settings.

All three students made improvement in responding to questions, which is a vital communication skill in the classroom. It allows teachers to assess student comprehension as well as better meet individual student's needs. It appeared that all students were engaged in the academic lessons as they scanned the vocabulary words available on the screens so they could touch them and respond to the teacher's questions.

All three students showed improved ability to make appropriate social comments. For example, Eric initially made increasingly independent comments only needing higher level prompts when he was not feeling well during the last week of intervention. Christian and Samantha also made increasingly independent comments but reached a plateau in prompt reduction, continuing to require either a verbal or gesture prompt to make a social comment. Encouraging social comments from the students promoted awareness of others in their environment.

The results are consistent with findings of the study by Kagohara et al. (2012), and expanded the research by using the SonoFlex application as AAC to support non-verbal students with low-functioning autism. It seems that iPads are viable technological aids. Using the SonoFlex application as the communication program could promote generalization of communication skills to other settings with typical peers and school personnel during the school day as the students join with others during lunch, recess and errands to the office.

The teacher and her assistants found that students enjoyed having their iPads. They willingly took it with them throughout the day i.e., to lunch, gym, music and art. They took it on community-based instructional trips and used it to order food items and make socially appropriate comments with their classmates, for example, when playing bowling, they used their iPads to communicate with each other during the game. It appears that having the iPad function as a multiple-use device was very helpful to the students and teachers. The apps included calm-down counters, educational apps, timers, stories, games, music, etc. These functions were always available for students' use to meet their various needs during the day. Meanwhile, the teacher also noticed an increase of typical peers who were willing to approach and interact with the non-verbal students while they were using their iPads. Using an iPad with its activities provided a common ground for socialization and increased their interest in positive social interactions.

Students with low-functioning autism responded positively to using the iPad with the communication application. They were learning to initiate requests, respond to questions and make social comments in academic and social settings with a decreasing level of prompt support when provided instruction using a least-to-most prompting hierarchy. Based on this evidence, the following plan of action is recommended:

- Select the most appropriate communication application for each student
- Continue to provide instruction in using the iPad as a communication device
- Meet with the family when each student meets a certain criterion (80% independent responses) and encourage them to purchase and use the iPad with their student for better communication
- Begin generalization of student's communication skills to other environments, adults and peers

Limitations

There are some limitations in the study. First, only three participating students and a short time period of 6 weeks may be difficult to generalize the findings to other settings and students. Teaching a new skill to students who generally require significant amounts of instructional time to develop proficiency in new skills was a challenge. Continued intervention is needed to determine the potential for independent communication from students with LFA. Second, the SonoFlex app has some limiting features, such as a fixed icon size and all related vocabulary visible on the same screen. Some students may be more successful with larger and fewer icons on a screen, which can link to more specific vocabulary as the student develops proficiency in AAC use. Selecting the most appropriate AAC app for each student based on individual needs rather than using the same communication application for all students in a classroom should be encouraged. In this study, due to some fine-motor and attention deficits, Eric may have had a more successful intervention had he been using a program with larger and fewer icons on each screen.

Implications

Communication skills are very important for individuals with LFA. They need an AAC device to express themselves, present their needs and wants, and interact with their teachers, peers, friends and family. Currently, there are many AAC devices on the market for families and schools to select, however, most of these dedicated devices (function only as AAC) are very expensive. An iPad with apps provides an alternative opportunity for these students. Many families may already have iPads in their homes and are already comfortable and familiar with their use. Teaching them how to use a relatively inexpensive communication app that can be easily downloaded for their child to access, may lead to improved communication between those with and without autism.

Recommendations and Conclusions

Further studies are needed to continue to supply empirical data to validate the use of an iPad as a communication device. Providing a longer period of time for the intervention with larger groups of students would allow for the results to more accurately reflect the potential of the iPad to be used as AAC. Additionally, teachers, aides and parents would benefit from specific training and practice in proven intervention techniques to provide instruction of the iPad for communication purposes.

The iPad used as a VOCA may be a key to unlocking the door of spontaneous, functional communication for students with LFA. It is the responsibility of those charged with their care to provide these students with appropriate communication instruction and the opportunity to choose to enter the world of language with a proven, successful tool, which may prove to be the iPad.

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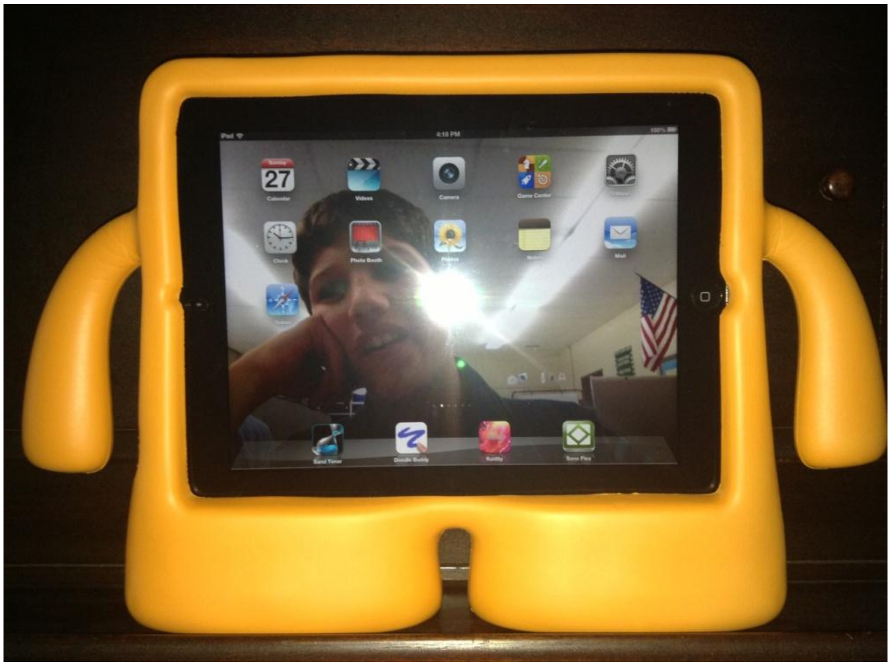
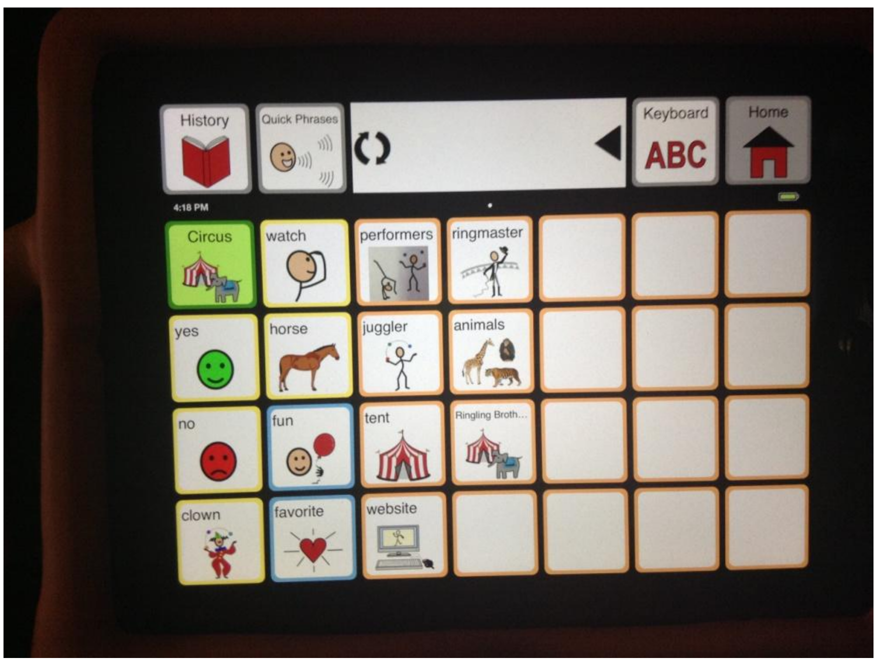
Appendix A. Example of the iPad Screen and App



iPad in protective cover (Home Screen)



Vocabulary Screen for “Social Studies” Context Button

Appendix B. Examples of Context Buttons and Associated Vocabulary Words

SonoFlex Context Buttons

Vocabulary Buttons

Morning Meeting	Math	Reading*	Social Studies*	I want	Being Friendly	Bowling
Monday	0	Emily	circus	food	My name is	Shoes, size
Tuesday	1	Touch	fun	drink	Hi	Ball
Wednesday	2	Taste	juggler	bathroom	Bye	Strike
Thursday	3	Smell	ringmaster	break	Classmate	Spare
Friday	4	See	animals	outside	Classmate	My turn
January	5	Hear	elephant	iPad	Classmate	Your turn
February	6	I	lion	home	Classmate	Thanks!
March	7	Can	tiger	Smartboard	Staff	Bathroom
Gym	8	Birthday	horses	O.T. room	Staff	Drink
Music	9	Red	website	book	Staff	Snack
Library	10	Loud	train	Quiet	Staff	I'm tired
Sign Language	add	Sweet	Ringling Brothers	Help	School Name	That was fun!
Sunny	subtract	Rough	January	yes	My turn	Thank you
Rainy	more	Good	I	no	Your turn	Bus
Snowing	less	Ran	like	More, please	Thanks	Break
Cold	the same	Man	work	Go home?	I had fun!	I did it!
Hot	all done	Van	yes		Stop, please	Yes
Yes	yes	Fan	no		I'm good.	No
No	no	Yes			I'm sorry.	
		No			Yes	
					No	

*The words are changed to match the current lesson being taught.