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Abstract

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Jamy H. Meeks
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Keywords: autism spectrum disorder, iPad, augmentative and alternative communication, communication interventions, requesting skills

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Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disability which usually emerges within the first three years of life and embodies the following characteristics: deficits in both verbal and nonverbal communication, impaired social interaction, and unusual and repetitive behaviors (American Psychiatric Association, 2013). The number of children diagnosed with ASD is on a continuous rise; according to the Centers for Disease Control and Prevention, "one in every 68 children in the United States has been diagnosed with ASD, a 78% increase in prevalence in six years" (Rice et al., 2012, p. 6). Rice et al. (2012) indicate that some possible reasons for this increase are enhanced tools to assess, improved screening methods, changes in diagnostic criteria, increased parental and physician awareness, and changes in available services. Prevalence of ASD has also been noted in families with higher socioeconomic status (Nwokeafor, 2012; Rice et al., 2012). There are numerous proposals as to why the amount of children with ASD has increased so considerably, but there are still too many contributing factors to determine an accurate cause.

Communication is a fundamental life skill; unfortunately students with Significant Developmental Delays (SDD) and/or ASD struggle with this concept (Duffy & Healy, 2011). Because communication is an essential skill, it is imperative to find interventions to support students with this delay. Further research into the use of augmentative and alternative communication (AAC) interventions is necessary to assist in unlocking potential for students with disabilities.

Communication deficits associated with ASD can impact all areas of a student's life. Students with ASD often struggle with expressive language (Light & McNaughton, 2014). According to Chiang and Lin (2008), 19% -59% of students with ASD do not develop speech, and a significant number of the remaining have limited functional spoken language. Naturally the severity of ASD has a negative impact on expressive communication (Chiang & Lin, 2008). Often students with ASD also demonstrate discrepancies developing and maintaining relationships with their peers, and they exhibit deficits in understanding the intricacies of social communication (Hart & Whalon, 2012). Because many students with ASD have limited communication skills, their eccentric behaviors while attempting to communicate further isolate them socially (Thatcher, Fletcher, & Decker, 2008). Students with communication disorders display errors in behavior regulation skills. To be successful in school, students must be proficient in following classroom routines, managing time, and interacting with peers, all areas of concern for students with ASD (Thatcher et al., 2008). Appropriate communication skills are a necessity for students to be successful in society.

Communication Interventions

Since effective communication is paramount for school success, and the number of ASD diagnoses are increasing, it is imperative to determine productive interventions to enhance these necessary skills in students. Therefore AAC interventions have been used to improve communication as well as social skills for students with ASD (Gordon, Pasco, McElduff, Wade, Howlin, & Charman, 2011). According to Duffy and Healy (2011), AAC communication strategies are used to assist students by supplementing their existing speech or to function as their primary method of expressive communication. These strategies are divided into two categories: unaided AACs which do not require any external equipment (manual signs and

gestures), and aided AACs which require external equipment (visual symbol cards, or voice output devices/speech generating devices; Duffy & Healy, 2011). With appropriate AAC interventions, most students with disabilities are able to learn how to express themselves (Duffy & Healy, 2011).

Communication interventions must concentrate on developing and sustaining communication skills in students with complex needs. Using an AAC device for requesting items only is no longer acceptable; the AAC instrument must also assist students in expressing needs, exchanging information, and participating in social communication (Light & McNaughton, 2014). Over the past 30 years, AAC interventions have improved a great deal. The most common approaches are sign language/total communication, communication systems that use visual-graphic symbols, and speech generating devices (SGD; Light & McNaughton, 2014). According to Nunes (2008), total communication (sign language and speech) has been an effective technique for students with ASD; providing sign language in addition to speech offers a visual representation for these highly visual learners. The use of graphic symbols to communicate allows students with limited prerequisite skills and cognitive deficits to depend on recognition rather than recall memory (Nunes, 2008). This system focuses on students identifying picture cards in order to communicate. In addition to providing students with a means of communication, picture exchange systems have also proven to assist students with behavior regulation and on-task behaviors (Nunes, 2008). The SGD systems furnish a more portable technique to communicate. Students use the device to select a graphic symbol or words and the device states the request or idea. With the growth of technology, SGDs are promoting a more socially acceptable form of alternative communication (Light & McNaughton, 2014; Nunes, 2008). Many students may need a combination from the repertoire of available techniques

(unaided AAC, low-tech aided AAC systems, and high-tech AAC systems) in order to fully thrive in school and society (Light & McNaughton, 2014). To ensure the educational and societal success of students with ASD, appropriate interventions must be implemented.

Picture Exchange Communication System (PECS). Determining the appropriate AAC interventions for students with communication deficits is ever evolving. In 1985, Bondy and Frost developed a unique communication tool known as the Picture Exchange Communication System (PECS). PECS is an aided communication intervention that can increase communication and decrease maladaptive behaviors in students with ASD (Ganz et al., 2008; Pasco & Tohill, 2011). PECS uses picture cards as a vehicle for communication by providing students with visual cards and allowing them to select the cards in order to exchange it for a desired item (Ganz, Sigafoos, Simpson, & Cook, 2008). PECS is a widely used intervention for students with ASD. According to Pasco and Tohill (2011), there are six phases in the PECS system which begins with making requests, then responding to questions, and ultimately to constructing sentences with multiple picture and word cards (a brief description of each phase of PECS is located in table 1). The first two phases require two instructors; one as the communication partner and the other to physically prompt the child (Ganz et al., 2008).

Table 1

Six phases of Picture Exchange Communication System (PECS) training

Phase	Teaching target and description
I	Make requests Student selects a single picture of a desired item and places it in the communicative partner's hand. The partner provides the student with the desired item and verbally states the name of the item. A second instructor is used during this phase as a physical prompter.
II	Persistence in initiating communication Student physically moves to their communication board, removes the picture of the desired item, and travels to their communicative partner to request their item. A second instructor (the physical prompter) is also needed during this phase.
III	Discrimination between symbols Student physically moves to their communication board, selects the appropriate symbol (from a variety of desired and non-desired items), and travels to their communicative partner to request their item.
IV	Introduction of sentence structure Student begins using multi-word phrases to request items. They combine the "I want" card in combination with the desired picture card to request items from their communicative partner.
V	Answering questions Student begins answering the question, "What do you want?" with the "I want" and picture card for desired item.
VI	Commenting Student answers questions such as, "What do you see/hear?" "What do you have?", "What is it?" and comments and requests spontaneously.

Note: Adapted from Flippin, Reszka, and Watson (2010) and Pasco and Tohill (2011)

In order to provide students with ASD an opportunity to effectively communicate, a number of studies have investigated the impact PECS has on developing and improving communication in this population of children. Gordon et al. (2011) investigated PECS to determine if the intervention increased spontaneous communication of students with ASD. They were specifically interested in confirming if the PECS system also generalized to speech and if communication improved for social purposes in addition to requesting items. Eighty four children with a formal diagnosis of ASD and very limited communication skills were selected for

this study. The participants were between the ages of 4 years and 11 years, and consisted of 73 boys and 11 girls in 15 elementary schools for students with disabilities in Greater London and South East England. A group-randomized control trial was performed over a 20 month period. Groups of children were placed into one of three intervention groups; the immediate treatment group (ITG; 26 children in 5 class groups) received training immediately after baseline, the delayed treatment group (DTG; 30 children in 6 class groups) received training 9 months later, and the no treatment group (NTG; 28 children in 6 class groups) received no training. The results in this study led authors to determine the ITG and the DTG groups' improved spontaneous communication using picture cards and also used speech or vocalizations, however at the end of the study 12 students overall were still not using picture cards at all and nine were still not making requests. After performing this study, Gordon et al. (2001), concluded there is a correlation between the severity of ASD and the effective use of augmentative communication devices. Even though there were some discrepancies in the study, the researchers confirmed the belief that aided communication is beneficial for students with ASD.

Speech Generated Devices (SGD). Most of the research over the last 30 years has focused on the impact of PECS and similar low-tech aided communication interventions on students with ASD and other communication disorders; however with the increase in innovative high tech devices, SGD have shown a rise in the field of communicative research (Thatcher & Decker, 2008). SGD systems are electronic apparatuses that consist of an individual communicating by pressing a button or a picture on a screen which will elicit a vocal message (Lancioni, O'Reilly, Curvo, Singh, Sigafoos, & Didden, 2007). Although SGD have been in use for many years, the recent technology explosion of smart phones, iPads, and other hand held personal devices has increased the use of high tech AAC devices among students with ASD

(Lorah, Tincani, Dodge, Gilroy, Hickey & Hantula, 2013). According to McNaughton and Light (2013), these mobile technologies have increased the awareness and social acceptance of AAC devices, provided consumers with greater access solutions, increased adoption of AAC technologies, and promoted additional circulation of AAC research. These improvements in SGD technology has made a positive impact on students with disabilities.

Because PECS is labor intensive for teachers, and can become increasingly difficult to use as the student increases his picture vocabulary, De Leo, Gonzales, Battagiri, and Leroy (2011) investigated the use of the PixTalk Communication System. This system "consists of a touch screen Smart phone application" the students use and a "companion website" which collects frequency data for teachers (p. 704). The authors conducted a case study with three students diagnosed with ASD, who were already trained in the PECS system, to determine if PixTalk was a better communication tool than PECS. Teachers completed a daily questionnaire rating PixTalk and PECS; the frequency log for each student was also evaluated to determine the number of pictures each participant accessed. The researchers concluded students preferred PixTalk over PECS, and proved that frequency data can be collected objectively through the companion website. De Leo et al. (2011) indicated that computer interventions are effective in improving communication among students with ASD because the devices provide motivation and aids in increasing the student's attention. The small sample size is a limitation, but since this was the first evaluation of PixTalk, additional research needs to be conducted to determine if the author's evaluation of the program is sufficient. The researchers also determined that students with poor fine motor skills may perform subpar with this system. With the ever evolving technology available, researchers should continue to investigate these communication interventions.

In 2010, the Apple iPad was introduced, which led to the expansion of SGD (Flores, Musgrove, Renner, Hinton, Strozier, Franklin, & Hill, 2012). There are many communication applications available for the iPad; one explored by King, Takeguchi, Barry, Rehfeldt, Boyer, and Mathews (2014) investigated the Proloquo2Go program. This application provides the user with a large display screen with large icons, it is lightweight, it can be easily individualized, it offers a voice output, it is reasonably affordable, and it is socially more acceptable (King et al., 2014). The focus of the study by King et al. (2014) was to determine if the iPad with the adapted PECS system of the Proloquo2Go would lead to participants acquiring requesting skills and increase vocalizations. The researchers focused on three preschool students with ASD in a self-contained special education classroom. A multiple probe design across participants was used with the intervention staggered across participants. After baseline, each participant received training based on an adapted version of the first four phases of PECS. All participants mastered Phases 1-3, but time ran out before Phase 4 (using the phrase "I want" and item) was introduced to them all. Vocalization increased for two of the participants and emerged for the other. This study provided a promising development for students with communication disorders. King et al. (2014) affirmed that the iPad is far less expensive than other SGD, and the iPad may be used to provide immediate reinforcement (games, videos, and etc.) for performing as expected. Some technological problems occurred during this investigation, but the problems were able to be corrected easily. King et al. (2014) also concluded that the inadequate time to perform the study was a limitation, however many studies involving the implementation of PECS never advanced past Phase 4. As with most studies involving students with disabilities, additional research involving the iPad with the Proloquo2Go application should be investigated in order to determine the effectiveness of teaching requesting skills and establish generalization.

As advancements occur with technology, there is a continual need to determine if SGD are more effective in teaching manding skills to students with ASD and communication disorders. According to Lorah et al. (2013), comparison studies involving the effects of PECS and SGD have yielded mixed results; therefore the researchers investigated the acquisition of requesting skills by comparing the two devices. The researchers also assessed the children's preference for each device. For this inquiry, five male students diagnosed with ASD between the ages of 4 years and 5 years were studied in their classrooms. None of the participants had any formal mand training using either PECS or an iPad. An alternating treatment design after baseline was conducted; PECS and iPad trainings were presented in random order across participants with equal number of training sessions across each device. Request training consisted of 15 trials per session with a maximum of two sessions per day. Frequency data were collected to determine independent and prompted requests. Training sessions continued until participants met mastery of 80% of unprompted requesting across two consecutive sessions. After mastery of each device, a preference assessment was conducted; this consisted of three to four 10 minute assessments in which the devices were presented in random order. Lorah et al. (2013) determined the iPad produced higher rates of independent requesting with an average of 85% while PE generated an average of 64%. Four of the five participants preferred the iPad over PECS; which differed from the results researchers found in the investigation by Flores et al. (2012) where participants made no clear preference for either device. Future research should focus on the effects SGD have on vocalizations, disruptive behaviors, and social communication. Generalization across settings and communicative partners should also be further investigated (Lorah et al., 2013). With persistent advancements in available technology, continued research

focusing on aided AAC devices should be performed in order to determine the most effective interventions for improving communication skills among students with ASD.

AAC progression. With the advancements in AAC strategies as well as a greater understanding of students with ASD, most researchers have determined that PECS and SGD are more beneficial than manual sign in teaching communication skills (van der Meer et al., 2012). Gone are the days of believing that language must be based solely on speech; aided AAC interventions have paved the way for nonverbal individuals to improve their communication skills. Researchers and clinicians have adopted the belief that interventions should focus on enhancing the abilities of students with disabilities rather than concentrating on their inabilities (Mirenda, 2001; Nunes, 2008). With many research investigations focusing on students who have already been exposed to one or more AACs, more research needs to focus on early elementary students with communication deficits and using iPad technology to improve communication.

The purpose of this study is to answer the following questions:

1. What effect does a commercial AAC application have on requesting skills in students with ASD who have communication deficits?

2. Can students with ASD who have communication deficits be taught to use a commercial AAC application to request items across settings?

Method

Setting

System. The setting consisted of a public preschool in a rural area of southeast Georgia. The school system contained 5,596 students and 360 certified teachers. There were

approximately 750 students with disabilities, and the cultural makeup of the system was 65% Caucasian, 25% African American, and 10% other.

School. The preschool consisted of approximately 260 students; 20 of which were students with diagnosed disabilities. Of the 20 students with disabilities, 8 were taught in a self-contained setting. Employees consisted of 13 general education teachers, 2 special education teachers, 15 paraprofessionals, a resource coordinator, a part time speech teacher, and a principal.

Classrooms. This study took place in two different classrooms. The first intervention occurred in a self-contained special education classroom for students with ASD and SDD. The room was approximately 28 feet by 25 feet. The class consisted of five male students with one special education teacher and one paraprofessional. Snack time transpired at the kidney table in the classroom, so the iPad and communication application were introduced at this location. The second intervention occurred in the general education classroom during center time. This class contained 18 general education students, 2 students with diagnosed speech and language disorders, a general education teacher, and a paraprofessional. Selection of a center activity using the iPad took place on the carpet where students were waiting to begin their chosen activity. The final intervention occurred in the same general education classroom as intervention two, but during snack time. The participants were seated at a rectangular table with 7 of their general education peers.

Participants

Students. The study included two preschool students who were diagnosed with ASD and demonstrated deficits in communication, and will be referred to as Aiden and Kasie in this report. The students in the study (a) qualified for special education services with an ASD

diagnosis; (b) were between the ages of 3 and 5 years, (c) demonstrated deficits in communication; and (d) were physically able to reach out and touch icons on an iPad. Students who did not have an ASD eligibility, who were not between the ages of 3 and 5, who did not demonstrate deficits in communication, and who had physical impairments that prevented them from touching icons on an iPad were excluded from the study.

Aiden was a 4 year old Caucasian male who was diagnosed with a Speech and Language Impairment at the age of 3 and was recently diagnosed with ASD. There is a family history of ASD for Aiden, for his 5 year old brother was also diagnosed with ASD at the age of 4. Aiden was able to squeal and make noises, but he did not use any words to verbally communicate. He demonstrated very little eye contact, and he indicated pleasure by smiling and laughing and discontentment by crying. His gross motor skills were in the average range, but fine motor skills were in the delayed range. Cognitively, Aiden was able to sort and match items by shape, color, and size and could use a writing utensil to mark on paper. He was toilet trained and followed one and two step directions.

Kasie was a 5 year old Caucasian male who was diagnosed with ASD and a Speech and Language Impairment at age 2, and began receiving services through Babies Can't Wait prior to attending public school. Kasie was able to repeat some phrases and imitate his teachers. He demonstrated pleasure by smiling, laughing, and squealing and discontent by screaming and banging on items with his hands. His gross motor skills were in the average range, but fine motor skills were very limited. Cognitively, Kasie was able to occasionally verbally count to 3 and would sometimes sing parts of the alphabet, but he did not match items by color or shape and rarely tolerated hand over hand assistance in using a writing utensil. He was not yet toilet trained, and required assistance in completing one step directions.

Independent Observer. A special education teacher possessing a Bachelors of Education degree and 10 years of teaching experience served as an independent observer for reliability and fidelity for 20 percent of the sessions. The students were familiar with her for she had taught them the previous school year.

Researcher. The researcher, who was the author of this paper, held a Master's Degree in special education and was working towards her Specialist Degree in special education. She had been teaching special education for 19 years and had experience in the self-contained and resource special education settings as well as the co-taught general education setting. She was experienced in various communication interventions and this was her second year working with preschool students.

Training assistant. The paraprofessional in the self-contained classroom has an Associate's Degree and 12 years of experience in the special education preschool class. She assisted the researcher with training the students to use the iPad.

Research Design

Due to the small sample size and the specific criteria for participation, a single subject design was used for this study. Using a single subject design allowed students to serve as their own control group and provided the researcher with an explanation as to whether an intervention functioned as expected (Gast, 2010). A multiple baseline across settings was used because little research involving AAC devices across settings is available. Although implementing a multiple baseline approach is time consuming, it increases internal validity and is suitable for teaching non-reversible functional skills (Gast, 2010). Baseline data were collected for a minimal of four sessions or until data was stable with a zero-celeration trend (Gast, 2010). Once baseline was established, the researcher trained the students to use the iPad

with the Go Talk Now communication application. Training took place for five days for one student and seven days for the other. After training concluded, the first intervention was introduced during snack time in the special education classroom. Data were collected until five consecutive data points were stable at 80% or higher. After data were determined stable, the second baseline and intervention were introduced during center time in the general education setting. Once again, when data were stable across both baselines and interventions, the intervention for snack time was intended to be generalized to the general education setting, but neither student tolerated the change in setting.

Independent Variable

The practice of incorporating AAC strategies are used to supplement a student's existing speech or to function as their primary method of expressive communication (Duffy & Healy, 2011), therefore an Apple iPad with the Go Talk Now communication application was used to address requesting skill deficits in students with ASD.

Dependent Variable

The dependent variable for this study was the skill of requesting items. After placing the iPad in front of the students and asking what they wanted for snack or what center they wanted to attend, the student would touch the iPad to make their selection. A correct response consisted of the student touching a picture icon on the iPad so that the picture became highlighted, or so that speech was generated on the device.

Materials and Equipment

Snacks. During snack time each day, four snack items were displayed in clear containers. Aiden's snacks consisted of goldfish crackers, fig newton cookies, chips, and oatmeal pies.

Kasie's snacks were saltine crackers, chips, applesauce, and goldfish crackers. The same four snacks for each student were used throughout the study.

Centers. During center time in the general education classroom, center choice pictures were located on a chart for all students to view. Four high frequency areas were identified for each student and consisted of the following: sand table, art, cars, and blocks for Aiden, and sand table, cars, blocks, and magnets for Kasie.

iPad. The portable, electronic Apple iPad was configured with the communication application Go Talk Now. The Go Talk Now application has been noted ideal for beginners to experience commercial communication applications and can be customized to contain from 1 to 25 images per page (The Attainment Company, 2015). The iPad contained four pages, one for snack and one for centers for each student. Each page contained four pictures of snack choices for snack time and four pictures of high frequency center activities for center time. The voice of a 10 year old boy was recorded to accompany each picture.

Data Collection

Snack time and centers. Frequency of communication behaviors were measured using event recording across settings. Communication behaviors were recorded on a data sheet (see Appendix A). Independent responses were defined as the student touching the iPad so that the picture became highlighted or so that the iPad generated speech. Incorrect responses consisted of students selecting an item on the iPad and then refusing to eat the selected snack or by selecting multiple buttons on the iPad whereas non-responses were defined as not selecting an item within 10 seconds of being requested. Independent responses were recorded using a plus sign while incorrect responses or non-responses were documented using a minus sign. The participant had an opportunity to respond up to five times per intervention. The percentage was

calculated by means of dividing the total number of independent responses by the total number of opportunities to respond within each intervention, and mastery was set at 80% for five consecutive sessions. An additional teacher observed 20% of the sessions for reliability and fidelity data. Data were stored in a locked file cabinet within the special education classroom.

Implementation Procedures

Participants were chosen from the researcher's self-contained preschool classroom based on inclusionary criteria. The researcher sent parents a letter of introduction (see Appendix B) as well as a parental consent form (see Appendix C). Once parental consent was obtained, training of additional school personnel began. Training of personnel consisted of data collection procedures to identify behaviors with reliability and fidelity. All teachers were informed of each dependent measure and all operational definitions. Data sheets and fidelity checklist (see Appendices A and G) were disbursed and explained so that personnel was familiar and confident with the process prior to the onset of the study. Precautions were taken to ensure validity, fidelity, and confidentiality of the research and its participants. Pseudonyms were assigned to student participants and instructors in order to safeguard the identification of all participants. The independent observer was required to read and agree to the observer consent (see Appendix D) and the paraprofessional was required to read and agree to the teacher consent (see Appendix E). Prior to every session, the child assent procedures (see Appendix F) were performed to ensure voluntary participation for each student.

Baseline I. Once the students agreed to participate, they were led individually to the intervention area and baseline data began. The students were shown the iPad and asked what they wanted for snack. The researcher used the data sheet (Appendix A) to record data. After

baseline was established for Aiden, training began with him and baseline data collection began with Kasie.

Training. During the training phase, the researcher held the iPad in front of each participating student and asked them what they wanted for snack. The paraprofessional was seated behind the student during this phase and physically moved the child's hand to the iPad and manipulated his hand to select a snack item. Students were verbally praised and provided with the snack. After seven training sessions for Aiden and five training sessions for Kasie, the implementation process began.

Intervention I. The first intervention phase occurred in the special education classroom during snack time. The students and teacher were seated at the kidney table and the participants were shown the iPad with pictures of snack options and asked to choose an item for snack. If the students did not make a selection within five requests, the iPad was removed from the setting and the students were provided with a snack of the teacher's choice. When the children chose a snack on the iPad, they were praised and provided with their snack of choice.

Baseline II. Once the students met mastery criteria for the first intervention, a second baseline phase began. During this phase, students used the iPad and communication application to select an activity during center time in the general education setting. The same procedures were followed for this phase as were completed in Baseline I and Intervention I. Once baseline criteria was established, the second intervention began.

Intervention II. The same procedures that were engaged in the first intervention phase were repeated in the new setting. This phase continued until mastery criteria was achieved.

Generalization. Once both interventions were attained, the final component was attempted. The plan for this stage consisted of the students using the iPad to select a snack in the

general education classroom; however both students refused to leave the special education classroom to attend snack time in the general education setting. Neither of the students was willing to adjust to the new setting. Although it was not part of the study, the iPad and Go Talk Now application was implemented successfully during circle time for students to identify colors and shapes.

Fidelity

Procedural fidelity were evaluated by a trained independent observer using a task analysis data sheet (see Appendix G). The independent observer collected data for 20% across all phases of the study by recording the number of steps completed correctly and the number that were not. Procedural fidelity was reported as a percentage of the steps completed correctly. There was 100% fidelity for 20% of the sessions observed by the independent observer.

Reliability

The same independent observer who collected procedural fidelity was also trained to collect reliability data using the same data sheet as the researcher (Appendix A). The researcher and the independent observer collected data independently. Using a point by point agreement ratio, the independent observer and the researcher were required to reach an 85% agreement during each phase of the study (Gast, 2010). Reliability was 100% for both Aiden and Kasie.

Data Analysis

Data were analyzed to document the effect an Apple iPad, equipped with the Go Talk Now application, had on the participants' communication. A multiple baseline across settings was used to increase validity and determine generalization (Gast, 2010).

In order to effectively evaluate the relationship between the independent and dependent variables, behaviors were graphed to distribute a detailed summary of each participant's

performance (Gast, 2010). The data were analyzed in all phases to document the impact of the iPad and Go Talk Now application on communication.

Results

Aiden

During the Baseline I phase, Aiden was observed over four sessions. His mean was 0; he did not attempt to use the iPad to request a snack item. During the Intervention I phase, he was observed over 15 sessions with a mean of 81.9. (Figure 1). During the Baseline II phase, he was observed over four sessions. Aiden's mean was 60.5. During the Intervention II phase, he was observed over 10 sessions. His mean was 89 and his behavior increased by 28.5 for an increase of 47%. Due to the change in requesting skills across settings, there is a functional relation between the implementation of an iPad with a communication application and an increase in communication behaviors for Aiden.

Kasie

During the Baseline I phase, Kasie was observed over four sessions. His mean was 0 for he did not attempt to use the iPad to request a snack item. During the Intervention I phase, Kasie was observed over 15 sessions; his mean was 95.3. (Figure 1). He also began verbalizing his request. During the Baseline II phase, his mean was 58.75. During the Intervention II phase, Kasie's mean was 90.2 and his communication behavior increased by 31.45 points for an increase of 53.5%. Kasie also began seeking out the iPad in order to request a snack. After five days of the first intervention, Kasie would locate the iPad and place it in front of him while waiting on the teacher to begin the process. Due to the change in requesting skills across settings, there is a functional relation between the implementation of an iPad with a communication application and an increase in communication behaviors for Kasie.

Figure 1

iPad Communication across settings
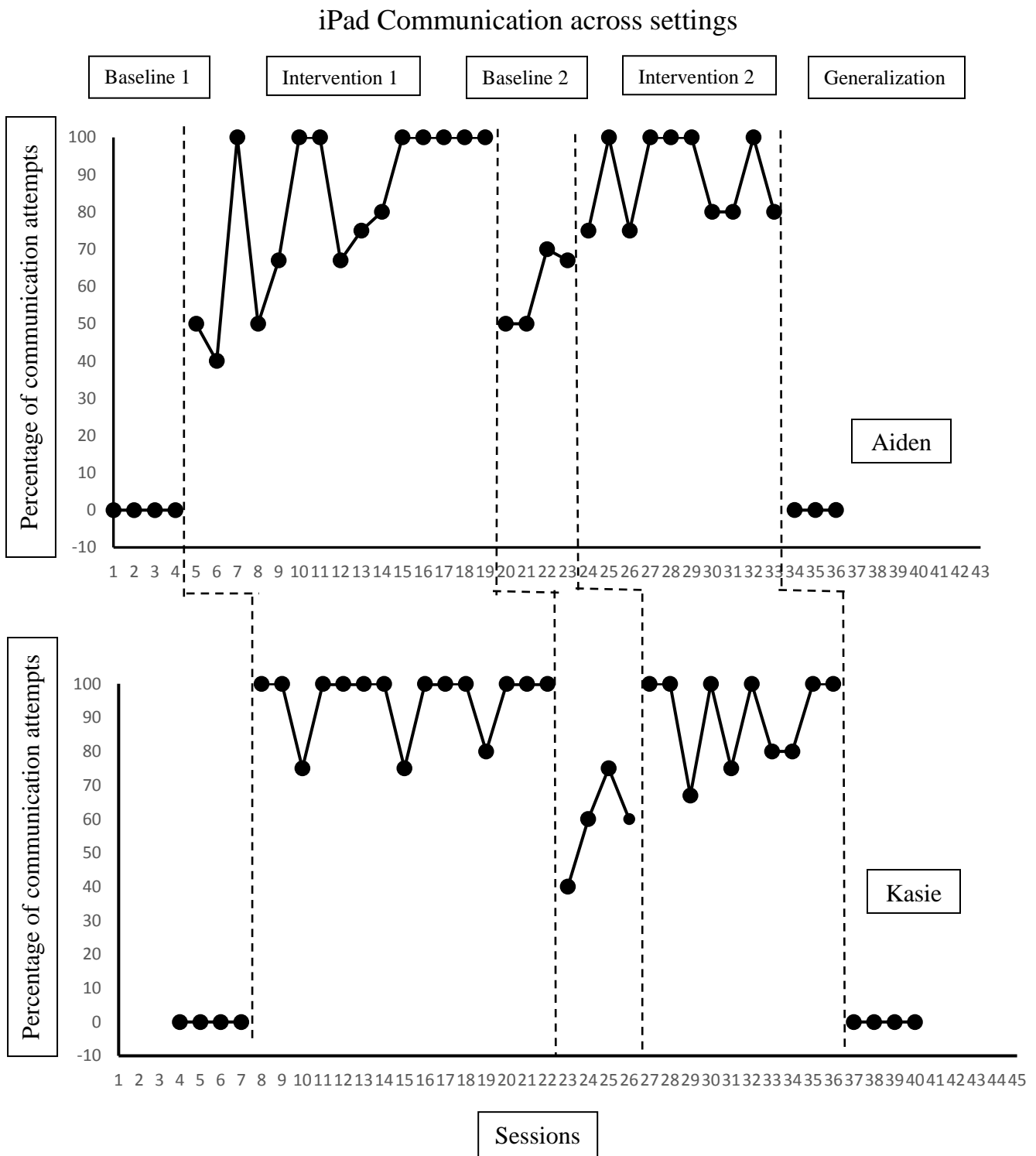
Discussion

The purpose of this study was to determine if the use of a SGD increased requesting skills in students with ASD and if the communication behavior transferred across settings. Both participants demonstrated an increase in communication using the iPad and Kasie exhibited more incidents in spoken language. Results of the study proved a positive implication on the use of SGD to improve communication among students with ASD and limited spoken language skills. Based on the findings of this study, in combination with existing research, a positive correlation between SGD and increased communication among students with ASD is probable.

Limitations and Future Research

Although the iPad and the Go Talk Now application were shown to improve requesting behaviors among students with ASD who display limited communication, there were some limitations noted in the study. Due to extraneous effects, special events at the school, field trips, and other changes in schedules, the students were not able to attend center time in the general education setting on a daily basis; this led to several lapsed days between intervention sessions. In the future, the researcher should identify these possible complications ahead of time and plan accordingly.

A second threat to external validity related to the small size of participants. With only two students participating in the study, the generalizability is limited. This study can be successfully replicated in additional setting in order to improve the generalizability.

Another limitation dealt with Baseline II. Since the iPad and communication application were taught prior to the first intervention, it was almost impossible to expect a zero-celeration trend for Baseline II. This limitation was however identified prior to the implementation.

Additionally only one communication behavior, requesting, was addressed. Further research should focus on implementing a communication device in all aspects of the school routine.

Furthermore, generalizing to a new setting for snack was unsuccessful because students with ASD do not adjust well with change. Since both participants demonstrated an increase in communication in two different settings, future research should focus on multiple settings and refrain from attempting to generalize the behaviors after being taught in a specific setting.

A final limitation that occurred involved the independent observer. During the study, the researcher determined that the independent observer did not agree with using technology for communication purposes and that she had no interest in research in general; this led to some negative attitudes and discord between the researcher and the independent observer. The independent observer also left the school during the middle of the research study, so the paraprofessional had to be trained as the independent observer. In the future, the researcher should determine beforehand that all adult participants are interested in the results of research based practices.

Since students did perform well with this AAC device, additional opportunities for use will be incorporated throughout the school day. These implementations will not only focus on requesting skills, but will also include academic skills. The speech teacher also plans to use the application with the students.

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Appendix A

Data Sheet

_____

Student Name

Condition:	Snack time (ST) or Work time (WT)
Environment:	Special education classroom (SE) or General education classroom (GE)
Criterion:	80% over 5 consecutive sessions

Operational Definition: When a student independently touches a picture on the iPad so that the picture is highlighted or so that the iPad generates speech, a plus sign should be given. If the student does not attempt to touch the iPad or manipulates the iPad in a different fashion (plays with iPad or tries to select a different application) a minus sign should be given. In the event of a non-response, student does not participate within 10 seconds of the request, a minus sign should be recorded. Participants will have up to 5 opportunities per session to respond.

Condition and Environment	Date				
	Plus (+) or Minus (-)				

Condition and Environment	Date				
	Plus (+) or Minus (-)				

Condition and Environment	Date				
	Plus (+) or Minus (-)				

Total: _____

Appendix B

Letter of Introduction of Research to Parents

****
Special Education
*********** Pre-K

RE: Research: Using an Apple iPad and Communication Application to Increase Communication in Students with Autism Spectrum Disorder

Dear Parents,

This fall I will be conducting research, Using an Apple iPad and Communication Application to Increase Communication in Students with Autism Spectrum Disorder, to fulfill a requirement for my Educational Specialist degree at **************** University. The purpose of this letter is to provide you with information about my research and the intervention I plan to use. If you have any additional questions or concerns, feel free to contact me for additional information.

My interest is in elementary aged students with an eligibility with Autism Spectrum Disorder who demonstrate deficits in communication. In an attempt to improve communication, I plan to use an Apple iPad with a commercial communication application in order to teach students to request items. The iPad and communication application will be used for two activities (snack time and center time). The iPad will contain four pictures (four snack items during snack time and four center activities during center time). The goal of the study is to increase requesting skills among students.

On the back of this page I would like for you to list your child's favorite snack items and to also choose the activities your child prefers. Please identify at least four items.

Since my research will focus on students under the age of 18, a parental consent will be necessary for student participation. Participation is completely voluntary and the parent and/or participant may refuse to participate or opt out at any time. Precautions will be taken to ensure confidentiality, and pseudonyms will be used to avoid identification of participants. Results of the research will be available upon request.

If you need to contact me, I will be available at the number below during the week from 7:30 am- 4:30 pm. Thank you for your time.

Sincerely,

****
(***)***-****

Favorite snacks:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Please circle the activities below that your child enjoys doing and rate them (1 being his favorite).

Wooden building blocks ____   Legos ____   Cars ____

Puzzles ____   Sand table ____   Art ____

Pretend play (kitchen/ dress up, etc) ____   Computer ____   Play dough ____

Books ____

Other: _____ ____

_____ ____

_____ ____

_____ ____

Appendix C

IRB Parent/Guardian Consent Form

I, _____, give permission for my child,
_____, to be a participant in the research Using Augmentative and Alternative Communication Devices to increase Communication, which is being conducted by ********, who can be reached at ***-***-****. I understand that my child's participation is voluntary; I can withdraw my consent at any time. If I withdraw my consent, my child's data will not be used as part of the study and will be destroyed.

The following points have been explained to me:

1. The purpose of this study is to determine if communication can be increased in students with Autism Spectrum Disorders when using an Apple iPad and a commercial Augmentative and Alternative Communication application.
2. The procedures are as follows: my child will be asked to identify their snack of choice and activity of choice by selecting a picture of their desired item on the Apple iPad. When my child makes their selection, they will be provided with the item.
3. You will be asked to sign two identical consent forms. You must return one form to the investigator before the study begins, and you may keep the other consent form for your records.
4. My child may find that some questions are invasive or personal. If your child becomes uncomfortable answering any questions, he or she may cease participation at that time.
5. Your child will not likely experience physical, psychological, social, or legal risks beyond those ordinarily encountered in daily life or during the performance of routine examinations or tests by participating in this study.
6. Your child's individual responses will be confidential and will not be release in any individually identifiable form without your prior consent unless required by law.
7. The investigator will answer any further questions about the research (see above telephone number).
8. In addition to the above, further information, including a full explanation of the purpose of this research, will be provided at the completion of the research project on request.

_____

Signature of Investigator   Date

_____

Signature of Parent or Guardian   Date

(If participant is less than 18 years of age)

Research at ************* involving human participants is carried out under the oversight of the Institutional Review Board. Address questions or problems regarding these activities to Dr. *************, **** IRB Chair, CBX 090, email: irb@****.edu; phone: (***) ***-****

Appendix D

IRB Observer Consent

I, _____, agree to participate in the research Using Augmentative and Alternative Communication Devices to increase Communication, which is being conducted by **********, who can be reached at ***-***-****. I understand that my participation is voluntary; I can withdraw my consent at any time. If I withdraw my consent, my data will not be used as part of the study and will be destroyed.

The following points have been explained to me:

1. The purpose of this study is to determine if communication can be increased in students with Autism Spectrum Disorders when using an Apple iPad and a commercial Augmentative and Alternative Communication application.
2. The procedures are as follows: you will be asked to observe the participant during the intervention and will collect data on a data sheet. This data will be used to determine reliability. You will also collect procedural fidelity.
3. You will not list your name on the data sheet. Therefore, the information gathered will be confidential.
4. You will be asked to sign two identical consent forms. You must return one form to the investigator before the study begins, and you may keep the other consent form for your records.
5. You may find that some questions are invasive or personal. If you become uncomfortable answering any questions, you may cease participation at that time.
6. You are not likely to experience physical, psychological, social, or legal risks beyond those ordinarily encountered in daily life or during the performance of routine examinations or tests by participating in this study.
7. Your individual responses will be confidential and will not be release in any individually identifiable form without your prior consent unless required by law.
8. The investigator will answer any further questions about the research (see above telephone number).
9. In addition to the above, further information, including a full explanation of the purpose of this research, will be provided at the completion of the research project on request

_____

Signature of Investigator   Date

_____

Signature of Participant   Date

- -

Research at ************* involving human participants is carried out under the oversight of the Institutional Review Board. Address questions or problems regarding these activities to Dr. ************, **** IRB Chair, CBX 090, email: irb@****.edu; phone: (***) ***-****

Appendix E

IRB Teacher Consent

I, _____, agree to participate in the research Using Augmentative and Alternative Communication Devices to increase Communication, which is being conducted by ********, who can be reached at ***-***-****. I understand that my participation is voluntary; I can withdraw my consent at any time. If I withdraw my consent, my data will not be used as part of the study and will be destroyed.

The following points have been explained to me:

1. The purpose of this study is to determine if communication can be increased in students with Autism Spectrum Disorders when using an Apple iPad and a commercial Augmentative and Alternative Communication application.
2. The procedures are as follows: you will be asked to physically prompt the participant during instruction of the communication device.
3. You will not list your name on the data sheet. Therefore, the information gathered will be confidential.
4. You will be asked to sign two identical consent forms. You must return one form to the investigator before the study begins, and you may keep the other consent form for your records.
5. You may find that some questions are invasive or personal. If you become uncomfortable answering any questions, you may cease participation at that time.
6. You are not likely to experience physical, psychological, social, or legal risks beyond those ordinarily encountered in daily life or during the performance of routine examinations or tests by participating in this study.
7. Your individual responses will be confidential and will not be release in any individually identifiable form without your prior consent unless required by law.
8. The investigator will answer any further questions about the research (see above telephone number).
9. In addition to the above, further information, including a full explanation of the purpose of this research, will be provided at the completion of the research project on request

_____

Signature of Investigator   Date

_____

Signature of Participant   Date

•••

Research at ************* involving human participants is carried out under the oversight of the Institutional Review Board. Address questions or problems regarding these activities to Dr. ************, **** IRB Chair, CBX 090, email: irb@****.edu; phone: (***) ***-****

Appendix F

Child Assent Procedure

_____   _____
                    Child's Name   Date

The instructor will not push for student participation in the study. Student will voluntarily

participate. Since the students in this study are between 3-5 years of age with cognitive

impairment, signature on an assent document would not be appropriate therefore, a verbal assent

was obtained using the following script prior to each session.

Script

1. Instructor: "Would you like to use the iPad?"

2. If the student is agreeable the instructor will direct the student to join her at the activity
   location.

3. If the student expresses a negative response or refuses to attend to the task, the teacher
   will wait a moment and show the student the iPad with item choices and then ask again; if
   the child continues to show a negative response, the teacher will wait until another day.

4. If a student refuses to participate 3 consecutive days the student will be dismissed from the
   study.

5. If at any time during the AAC intervention process the child becomes noncompliant
   or refuses to participate, the session will end immediately.

_____   _____
                  Researcher's Signature   Date

(If participant is less than 18 years of age)

Research at ************ involving human participants is carried out under the oversight of
the Institutional Review Board. Address questions or problems regarding these activities to Dr.
************, **** IRB Chair, CBX 090, email: irb@****.edu; phone: (***) ***-****

Appendix G

Procedural Fidelity

Student:_____   Date:_____

Number	Yes	No	Step Description
1.			Did the teacher ask the student, "Would you like to use the iPad?
2.			If the student indicated approval, did the teacher take the student to the correct area? If the student responded negatively did the teacher move toward the activity to demonstrate while inviting the student again? If the student refused to participate when invited a second time, did the teacher direct the student to an alternate activity?
3.			Did the teacher show the student the iPad and ask him which item he would like?
4.			Did the teacher provide verbal praise when the child used the iPad to request an item?
5.			Did the teacher provide the item of choice to the child after using the iPad to request an item?
6.			If the child did not attempt to use the iPad, was he redirected at least a total of 4 additional times to do so? (If needed)
7.			Did the child actively engage in the activity with the chosen item?
8.			Did the teacher end the session with a positive comment directed toward the student?