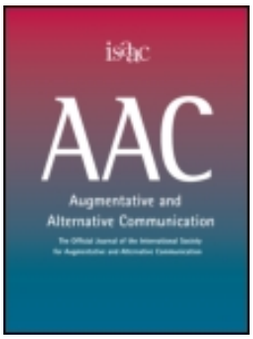

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INTERVENTION NOTE

A Comparison of Communication Using the Apple iPad and a Picture-based System

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Abstract
Augmentative and alternative communication (AAC) interventions have been shown to improve both communication and social skills in children and youth with autism spectrum disorders and other developmental disabilities. AAC applications have become available for personal devices such as cell phones, MP3 Players, and personal computer tablets. It is critical that these new forms of AAC are explored and evaluated. The purpose of this study was to investigate the utility of the Apple iPad™ as a communication device by comparing its use to a communication system using picture cards. Five elementary students with autism spectrum disorders and developmental disabilities who used a picture card system participated in the study. The results were mixed; communication behaviors either increased when using the iPad or remained the same as when using picture cards. The implications of these findings are discussed.

Keywords: *iPad; Augmentative and alternative communication; Communication intervention; Developmental disabilities*

Introduction

Individuals with developmental disabilities, including autism spectrum disorders (ASD), often present with deficits in communication, understanding language, play, development of social skills, and relating to others (Lindsey-Glenn & Gentry, 2008). Augmentative and alternative communication (AAC) interventions have been shown to improve both social and communication skills in children and youth with ASD and other developmental disabilities (Simpson et al., 2005). Use of AAC has become an essential part of language intervention programs for children with developmental disabilities who experience significant difficulties with communication and social skills (Mirenda, 2003; Romski & Sevcik, 1997). AAC interventions and devices that include visual symbols may appeal to the visual strengths of some students with ASD (Schuler & Baldwin, 1981).

Bondy and Frost (1994) described a system for communication that encourages behaviors such as persistence in communication by requiring that students exchange a picture for the desired item or activity. The Picture Exchange Communication System (PECS) has resulted in effective spoken communication that may include the support of pictures (Bondy & Frost, 1994; Ganz & Simpson, 2004). In addition to increased communication, the use of PECS has led to improved social interactions of students with disabilities, including increased initiation of play, and decreased tantrum behaviors and noncompliance (Anderson, Moore, & Bourne, 2007; Carr & Felce, 2007; Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002).

Pictorial symbols may also be included on speech-generating devices (SGDs) with synthesized or digitized speech. Olive et al. (2007) demonstrated that the use of SGDs combined with naturalistic instructional strategies resulted in improved communication for students with disabilities. The use of SGDs has been shown to improve communication and decrease inappropriate behaviors (Durand, 1999). Schepis, Reid, Behrmann, and Sutton (1998) found that the use of SGDs increased social interactions within natural settings of young children with disabilities, including ASD. Trottier, Kamp, and Mirenda (2011) found that SGDs increased the use of communication during social interactions with peers. Researchers have also compared non-electronic AAC systems and SGDs with regard to preference and acquisition (Canella-Malone, DeBar, & Sigafoos, 2009; Son, Sigafoos, O'Reilly, & Lancioni, 2006). Studies have demonstrated

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that the type of system does not affect acquisition rates, but that students may show individual preferences for specific types of AAC systems (Canella-Malone, DeBar, & Sigafoos; Son, Sigafoos, O'Reilly, & Lancioni, 2006).

There has been an increased interest in the use of portable media players and smartphones as SGDs, due to increased portability, peer acceptance, and convenience (Sennott & Bowker, 2009). Proloquo2Go™[1], an AAC application for the iPhone™, iPod Touch™, and iPad™[2] that includes over 8,000 Symbolstix symbols, has received a high degree of media attention. Since students with disabilities, including ASD, are generally able to access non-electronic communication boards or traditional SGDs by pointing, it is likely that they would be able to access mobile electronic devices that use SGD applications. However, there are motor access limitations associated with the use of mobile devices and applications such as Proloquo2Go (Sennott & Bowker, 2009). Researchers have provided instruction in order to circumvent these challenges. Kagohara et al. (2010) investigated strategies for teaching a student with ASD to use the iPod Touch as an SGD. Using delayed prompting and differential reinforcement, the researchers were able to teach the student to successfully activate an SGD application loaded onto an iPod Touch.

Personal devices have also been used for self-operated prompting. Cihak, Wright, and Ayers (2010) used an HP iPAQ Mobile Media Companion™[3] to display photographs of task engagement that were self-modeled by students. The researchers found that students' task engagement increased across tasks when they used the device for self-prompting. No significant differences in acquisition rate were found across AAC devices. Preference for particular AAC devices or systems appears to be individual to the student. None of these studies included cell phones, MP3 players, or personal computer tablets– types of devices may be more accessible due to their lower cost and availability to the general public. Therefore, the purpose of this study was to investigate the utility of the Apple iPad as a viable communication device for making requests and to compare its use with a non-electronic AAC system involving graphic symbols.

Method

Participants

The participants were five elementary school students with disabilities who attended a university-sponsored extended school year program in the southeastern United States. Each of the students qualified for special education services according to federal and state guidelines and received extended school-year services as indicated within their Individualized Educational Programs (IEP). The students' cognitive and spoken language abilities were evaluated by the lead researcher, who is qualified to administer such assessments. Cognitive ability was measured using the Leiter International Performance Scale Revised (Roid & Miller, 2002), a nonverbal test suited for children and adolescents who have cognitive delays, limited language, or limited English proficiency. Spoken language was measured using the Test of Language Development Intermediate, 4th edition (TOLD-I-4) (Hammill & Newcomer, 2008a) or the Test of Language Development-Primary, 4th edition (TOLD-P-4) (Hammill & Newcomer, 2008b) depending on each student's age. A total Spoken Language score was calculated for each student. Within the TOLD-P-4 and Told-I-4, the Picture Vocabulary subtest measures students' understanding of spoken language by requiring them to point to a picture that matches a spoken label provided by the test administer (one picture in an array of four pictures).

Max was a 9-year-old male with ASD who used a picture system to communicate simple requests within his home and local school. Max's oral vocabulary included less than five words according to his IEP. Sam was an 11-year-old male with multiple disabilities (intellectual disability and orthopedic impairment) who communicated using three- to four-word phrases with a picture system in his home and local school. Sam's spoken vocabulary consisted of less than 10 words. Al was a 9-year-old male with an intellectual disability whose spoken vocabulary consisted of fewer than 10 words; he communicated two- to three-word phrases using a picture system. Nick was an 8-year-old male with ASD who used a picture system at home and school to communicate one word at a time. Nick had no spoken words in his vocabulary. Nick responded to verbal instructions and directions without prompting (gestural or physical) approximately 70% of the time. Len was an 8-year-old boy with ASD who used a picture system at home and his local school to communicate using up to three-word phrases. Len had less than five words in his spoken vocabulary. The assessment results for each student are shown in Table I.

All participants received special education services under the categories of autism spectrum disorders or

Table I. Participant demographics.

Student	Age	Eligibility	Cognitive ability[a]	Language achievement[b]	Receptive vocabulary[c]
Max	9	Autism Spectrum Disorder	74	40	1
Sam	11	Multiple Disabilities	44	54	1
Al	9	Intellectual Disability	55	54	1
Nick	8	Autism Spectrum Disorder	36	62	2
Len	8	Autism Spectrum Disorder	56	62	1

[a]Standard score on the Leiter International Performance Scale-Revised. [b]Standard score on the Test of Language Development – Intermediate 4. [c]Scaled score on the Pictured Vocabulary Subtest of the Test of Language Development – Primary 4.

intellectual disability. A review of their IEPs revealed that all had IEP goals related to language and communication development. Although all of the students performed poorly on the receptive language subtest, they complied with classroom directions and participated in classroom activities involving verbal directions.

Setting

The setting was a university-sponsored summer program created to provide extended school-year services for students with disabilities. The program consisted of 5 weeks of service, 3 hours each day, 5 days per week. The students who participated in the study were enrolled in different classrooms within the program. They received instruction in classrooms with three or five peers with disabilities who were similar in age and academic need. The students' daily schedule included language/reading instruction, writing instruction, mathematics instruction, a snack activity, and incidental teaching within a recreational or play activity. The instructional content varied, based on the needs of students within each classroom. The classroom structure and instructional program were tailored to students' needs and included strategies such as small group direct instruction, discrete trial instruction, individual work systems, incidental teaching, and visual supports. Classroom staff members were two graduate students and one undergraduate student, each majoring in special education.

The study was conducted during snack time because this was a natural time for incidental communication instruction regarding requests. The snack activity occurred within the second hour of the program and was set at a kidney-shaped table. The snack activity occurred at least 2 hours after a student might have had an opportunity to eat, and no edible reinforcers were used prior to the snack activity.

Materials

Snacks. During each daily snack activity, three different snacks were displayed in clear plastic containers, and a drink was contained in a clear pitcher. The three snacks were the same each day (pretzels, cheese flavored crackers shaped like goldfish, and cookies). Each student requested the type of snack that he preferred.

Picture-based System. Students used the picture system, as described in their IEP, during snack time to request different types of food and drink. The teachers created laminated color picture cards, 1.5 inches by 1.5 inches, using Board Maker™[4] picture communication symbols for objects (pretzels, goldfish, cookies, drink) and requests (I want, more). The teachers secured a strip of Velcro to the table in front of each child's assigned seat. Picture cards were fastened to the Velcro strip and each child who used the picture system had his own set of cards. The arrays of cards differed based on the student's use of the system. For example, a student who used phrases had cards for *I-WANT* and *MORE* to pair with snack-related picture communication symbols, but the student who used one word had picture communication symbols for the snack items only.

iPad. At the time this study was developed, the iPad had not been released to the public. Although communication applications were available for similar devices, it was not clear whether such software for the iPad would be available in time for the research implementation. Therefore, a software design company (PUSH Design Inc.) created an application (currently commercially available through the Apple iTunes Store), called "Pick a Word," that allowed the student to touch a color photograph on the screen in order to make a request. Each item or request was depicted on the screen in a photograph. For example, the *PRETZEL* picture was a photograph of a pretzel. The *I-WANT* picture was a photograph of open hands together depicting the American Sign Language sign for I WANT. There were six picture icons displayed on the iPad screen. Each picture icon was 1.5 in (3.81 cm) square, with 1 in (2.54 cm) between the icons. There was no sentence window, nor was there a screen dynamic. The voice output corresponding to the pictures consisted of the following words and phrases: "*I want*," "*more*," "*drink*," "*pretzels*," "*goldfish*," and "*cookies*." Students could make one-word requests as well as three- or four-word requests in sentences (e.g., "*I want cookies*" or "*I want more goldfish*"). The application screen is presented in Figure 1.

Photographs were used because the Boardmaker picture communication symbols used for the picture system were not available for the iPad platform at the time of the study. The speech output consisted of a child's voice, recorded by a 10-year-old girl. At the time of the application development, the gender of the potential student participants was unknown and the researchers did not anticipate an all-male pool of student participants. The voice output was activated and the picture was highlighted when the child touched and released (contact with screen with a finger and released within a second). If the child touched the device with his finger but did not remove it within 1 s, the picture was highlighted but voice output was not activated. The device could not be activated if it was touched with a fingernail.

Design

The frequency of communication behaviors was compared under two conditions: a picture-based system and an iPad. Communication behaviors were not prompted beyond an initial verbal offer of a snack by the teacher. Communication behavior was defined for the picture-based system as one of the following: (a) pointing to a picture card, (b) removing a picture card from its Velcro strip (on table in front of the child) and giving it to the teacher, (c) or removing picture cards from the Velcro strip (on the table in front of the child) and placing them on a sentence strip. For the iPad, a communication behavior was defined as the participant (a) touching a

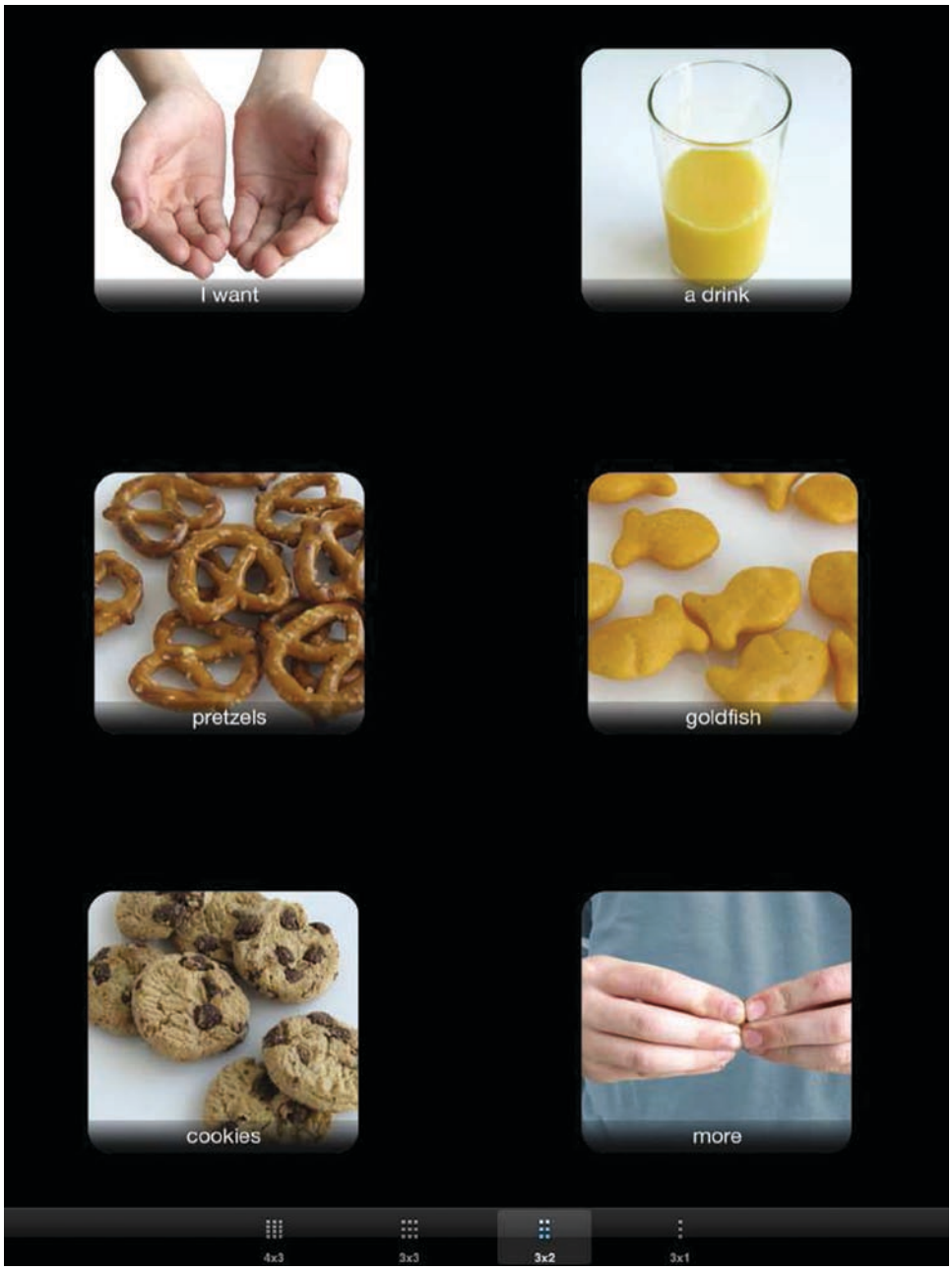

Figure 1. The Pick-a-Word application.

picture on the iPad screen such that the screen became highlighted, or (b) touching the screen such that the screen was highlighted as the iPad-generated speech. The highlighted screen-only was accepted as a communication response and resulted in delivery of a snack because there were instances in which a student's finger moved slightly as he touched the device, swiped his finger across the icon on the device, or touched it for more than one second. The researchers did not want to penalize the students for a potential weakness of the device. When these instances occurred, the student received the requested item and the teacher used a physical prompt to show him the correct action for activating the speech output.

The conditions were implemented in the following order: picture-based condition, iPad condition, picture-based condition, iPad condition, picture-based condition. Each condition was implemented for at least 3 days. The study ended with pictures because the students did not have access to SGD communication systems outside of the program.

Procedures

The snack procedures were the same each day. The students were instructed to check their visual schedules (laminated Boardmaker Picture Communication Symbols representing each activity fastened to a piece of poster board with Velcro in the order of each child's daily schedule) and to bring the snack activity card to the snack table. The food containers and the drink pitcher were in the middle of the table and napkins were

placed at each child's assigned seat. The teacher made a positive comment about the snacks (*Yummy snacks!*) and told the students that they would take turns asking which snack they wanted and if they wanted a drink. She asked the first student want he wanted. If the student responded using pictures or the iPad (depending on the condition) within 5 s she gave a small amount of food and/or drink. If the student did not respond within 5 s the teacher told him that it was the next student's turn and then asked the next student what he wanted. After the initial round of teacher-initiated opportunities for each individual student, the students, as a group, were offered more. The whole activity lasted for 15 min; for the last 10 min of the activity, all students had unlimited opportunities to request snacks.

Picture-based System. The students who attended the program had previously learned a communication system within their local schools. The picture system used in this study includes components based on the Picture Exchange Communication System developed by Bondy and Frost (1994). However, the student participants came to the program from different schools and school systems with different picture system experiences. In addition, the students only attended the program for ESY services and would return to their picture system after the program. Therefore, there are variations in this system from the research-validated system created by Bondy and Frost.

Using the snack procedures described previously, the teacher asked each student what he wanted. Those students using single words made a request by choosing the picture card representing the preferred item from the array and handing it to the teacher. The teacher took the card, gave the student a small amount of food or drink, and responded with a short positive reinforcement (e.g., *Nice asking, here are pretzels*). Students using phrases including *I-WANT* made a sentence on a sentence strip using picture cards from the array in front of him (e.g., *I-WANT PRETZELS* or *I-WANT MORE COOKIES*. One student in the program pointed to picture cards, using one-word responses. Since this was his learned system, no attempt was made to change it because this might have interfered with his performance, potentially making the iPad a preferred device over a novel communication system because it only required touching. After the teacher asked the students what they wanted initially, she asked the group, as a whole, if they wanted more, and responded to requests for more according to the procedures.

iPad. As none of the students had experience with an iPad prior to the study, each student received instruction regarding its use during snack time. First, the researcher and the teacher provided explicit instruction in the association between the photographs and the items or phrases that they represented. Once each student demonstrated that he could match each snack item or phrase to the corresponding photograph on at least three consecutive trials, the researcher and the teacher modeled the use of the iPad to request an item. Next, the teacher told the student that it was his turn for snack and asked what he wanted. If there was no response within 5 s, the teacher gave a verbal prompt to touch the screen. If there was no response within 5 s of the verbal prompt, the researcher provided a physical prompt by moving the student's hand to the device. A snack item was provided when the student touched a photograph on the iPad (prompted or unprompted). Practice sessions occurred until each student had independently touched one or more photographs and had received the appropriate snack item three times. The researchers concluded that, after successfully completing training, the students understood the meaning of the icons and the use of the iPad as a communication tool.

Following individualized training on the use of the iPad, each student was given the device to use during the snack activity. The iPad was placed on the table with the AAC application open and pictures for snack requests displayed; there was one iPad per student so that each had full access to the device. Students using one-word pictures made a request by touching the photograph representing the preferred item and making eye contact. The teacher gave the student a small amount of food or drink. The same procedures were used for students who used phrases.

Data Collection and Reliability

Event recording was used to measure the target behavior; each communication behavior, regardless of its length, was recorded as one event. Data were collected daily during the snack period by one of the teachers who was not implementing the snack activity. Frequency of communication behaviors was counted. Data collection training and inter-observer training consisted of supplying the teachers and doctoral students with an operational definition of the target behaviors and providing practice situations using the picture system and the iPad. Training was implemented until all individuals recorded communication behaviors with 100% agreement with the first author, across three responses.

Treatment Integrity. Treatment integrity data were collected across picture communication and iPad conditions. The treatment integrity checklist items were: (a) all necessary picture cards or iPad were in place prior to snack; (b) all necessary food and drink items were in place prior to the activity; (c) the students were called to the snack activity using their picture schedules; (d) the teacher made a positive comment about the snacks and told students that they would take turns asking for their snack; (e) the teacher asked each student what he wanted, using no more than five words; (f) the teacher only responded to student requests that occurred within 5 s of her question; (g) the

teacher responded to requests with no more than three pieces of food and verbal praise; and (h) after the initial round of teacher-initiated requests, there was 10 min for additional student requests. Treatment fidelity was 100% across all snack sessions.

Interobserver Agreement. Data were collected live by one of the teachers in the classroom who was not involved in the snack activity. Interobserver agreement data were collected live during 25% of the snack sessions. The observers were doctoral students in special education who were trained to record communication behaviors at the same time as the teachers. Interobserver data were collected regarding the occurrences of communication behaviors. Agreement was calculated by dividing the number of agreements (174) by the total number of agreements and disagreements (192). Interobserver agreement was 91% for the study. Interobserver agreement for each student was a follows: 92% for Al, 95% for Sam, 86% for Max, 96% for Nick, and 88% for Len.

Social Validity. Social validity data were collected using subjective evaluations related to the proposed goals and the results of the study (Kennedy, 2005). The researcher analyzed the students' IEPs and their local school-teachers' goals for ESY services. These documents were used to investigate the existence of an established need for intervention related to communication. Data were also collected using a questionnaire regarding the need for a communication system – both picture-based and iPad – as an SGD. Program staff completed the questionnaire before and after the study. The questionnaire consisted of statements with a four-item Likert scale (1 = true, 2 = somewhat true, 3 = somewhat false, and 4 = false) regarding communication needs and a picture-based system and an SGD, such as the iPad. In addition, the staff answered an open-ended question regarding their experience with the iPad. A copy of the social validity questionnaire is provided in Appendix A.

Results

The results for all participants were analyzed visually. The researchers noted differences in the frequency of communication behaviors by comparing data paths within pictured-based system conditions and the iPad™ conditions. The results are summarized in Figure 2.

Results for Max

Data were collected across three snack sessions on 3 days for the first picture-based condition. The mean number of communication behaviors was 6.7. When the first iPad condition was presented, there was an immediate change in the first data point compared to the last data point in the previous condition. The mean number of communication behaviors was 20.6. During the second picture-based condition, there was an immediate change in the first data point compared to the last data point of the previous iPad condition, and the mean level was 3.3 communication behaviors. During the second iPad condition, there was an immediate change in the first data point compared to the last data point in the previous condition, and the mean level was 8.5 communication behaviors. The mean number of communication behaviors during the picture-based condition was 0.5. The data for Max show moderate changes in frequency across picture-based and iPad conditions.

Results for Sam

Data were collected across three snack sessions on 3 days for the first picture-based condition; the mean number of communication behaviors was 10. During the first iPad condition, the mean was 14.3 communication behaviors; during the second picture-based condition, the mean number of communication behaviors was 12.3; during the second iPad condition, the mean number of communication behaviors was 12.3; and during the final picture-based condition, the mean number of communication behaviors was 7.5.

Results for Al

Data were collected across four snack sessions for the first picture-based condition. The mean number of communication behaviors was 4.8, demonstrating a stable pattern. During the first iPad condition, there was an immediate change in the first data point compared to the last data point in the previous condition, and the mean number of communication behaviors was 42.7. During the second picture-based condition, there was an immediate change in the first data point compared to the last data point in the previous condition, and the mean was 3.3 communication behaviors. During the second iPad condition, the mean number of communication behaviors was 23.3. During the final return to the picture-based condition, there was an immediate change in the first data point compared to the last data point in the previous condition, and the mean number of communication behaviors was 0.3. There were noticeable changes in level across picture-based conditions and iPad conditions.

Results for Nick

Data were collected across three snack sessions on 3 days for the first picture-based condition with a mean of 7.7 communication behaviors. During the first iPad condition, there was an immediate change in the first data point compared to the last data point in the previous condition, with a mean of 17.3 communication behaviors; during the second picture-based condition, there was an immediate change in the first data point compared to the last data point in the previous condition, and a mean of 7.3 communication behaviors; during the second iPad condition, the mean number of communication behaviors was 18; and during the final picture-based condition, there was an immediate

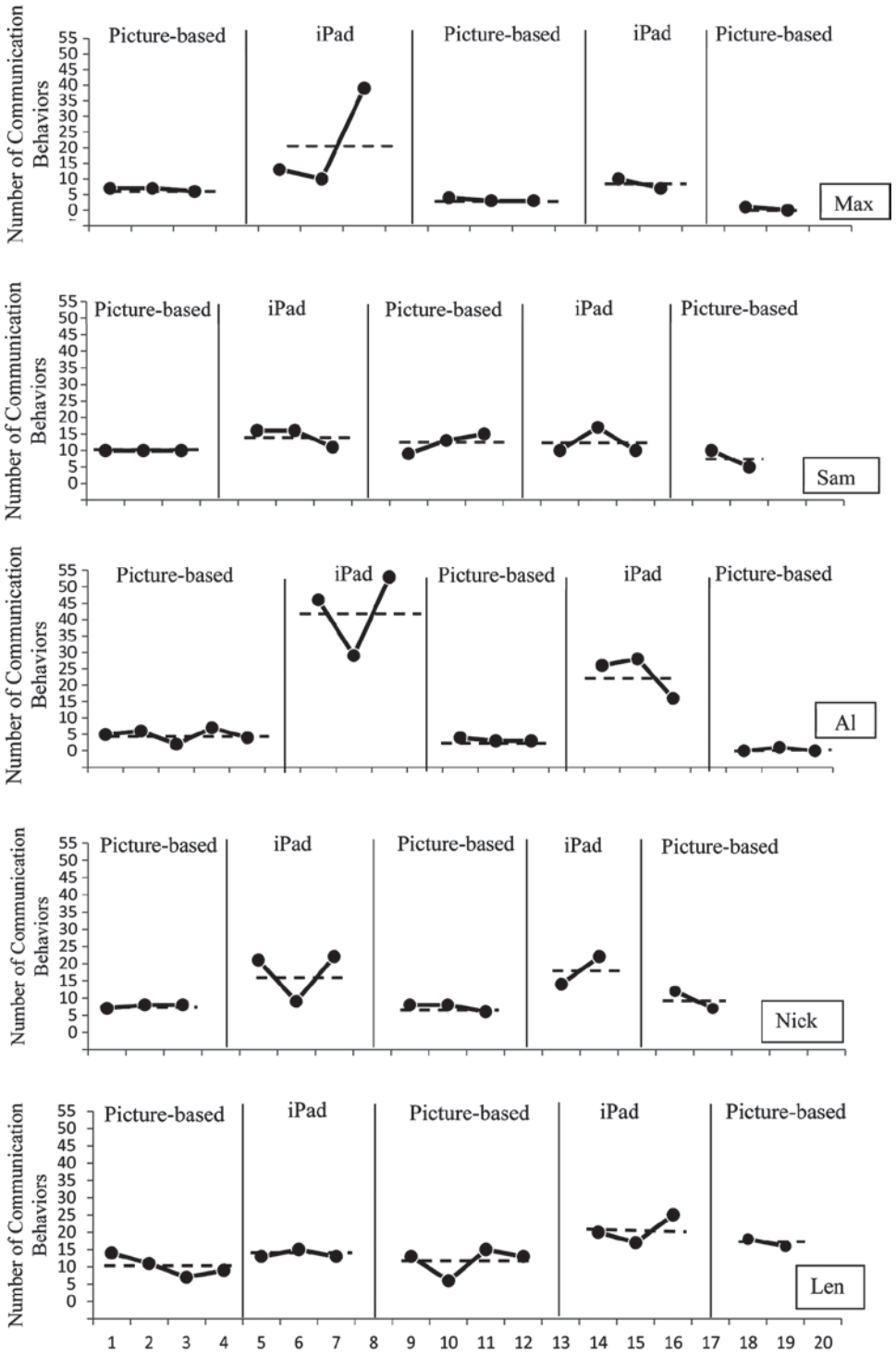

Figure 2. Results for Max, Sam, Al, Nick and Len.

change in the first data point compared to the last data point in the previous condition, and the mean number of communication behaviors was 9.5. Nick's data show moderate changes in frequency across picture-based and iPad conditions.

Results for Len

Data were collected across 4 days for the first picture-based condition, and the mean number of communication behaviors was 10. During the first iPad condition, the mean was 13.6 communication behaviors; during the second picture-based condition, the mean was 11.8 communication behaviors; during the second iPad condition, the mean number of communication behaviors was 20.6; and during the final picture-based condition, the mean number of communication behaviors was 17.

Social Validity

All of the participants' IEPs indicated significant deficits in their communication behavior prior to the study.

The IEP goals included increasing their use of a picture communication system, and their verbal vocabulary. On the social validity questionnaire, program staff indicated that there was a need for both general communication intervention and SGD communication intervention (as indicated by responses of "true" and "somewhat true"). In addition, they indicated that they were interested in using an alternate form of a communication system, in the form of an iPad (as indicated by responses of "true" and "somewhat true"). None of the staff indicated prior experience with the iPad; however, two of them indicated that they had experience with the iPod Touch and ProLoquo2Go. After the study, all staff members indicated that the following statements were true or somewhat true: (a) students appeared to like using the device, (b) using the iPad resulted in faster communication, and (c) the iPad was easier for students to manipulate. Staff also reported that use of the iPad was easier for them, as teachers, to implement and that they preferred the iPad over the picture communication system.

Discussion

The purpose of this descriptive study was to investigate the utility of the Apple iPad as a viable communication device by comparing the frequency of communication behaviors during conditions in which the iPad and a non-electronic picture-based system were used. The results were mixed. Al clearly showed more communication behaviors when using the iPad. There were no overlapping data points in adjacent phases for Nick and Max, demonstrating more communication behaviors using the iPad. These findings lend limited initial support for the iPad as a viable communication option, since it did not detract from students' established repertoire of skills.

With regard to preference, the findings from this study are consistent with other studies in which different AAC devices were compared (Canella-Malone, DeBar, & Sigafoos, 2009; Sigafoos et al., 2009; Son et al., 2006). There was some increase in communication behaviors with the iPad; however, there was no clear pattern across all students. As in other studies, the utility of AAC devices may be based on the individual's unique skills and preferences. This study did not evaluate preference by students with a choice as to which AAC device to use. However, anecdotal information suggests that two of the students preferred the iPad to the picture system. For example, during the three snack sessions of the second picture condition, Max refused to eat a snack during the first few minutes of the session and actively looked around the room for the iPad. Al also behaved in a way that indicated a preference. Each day of the second picture-based condition, when Al arrived at the snack table, he took his picture cards to the trashcan and threw them away.

Max demonstrated spoken language at the end of the study, using words to request his snack. He said, "*I want pretzels*." He had previously communicated in phrases using picture cards, but had not used speech to request items. This is consistent with previous research, in which the PECS system led to spontaneous speech (Bondy & Frost, 1994; Schwartz, Garfinkle, & Bauer, 1998). As with these studies, perhaps the use of one or both of the AAC systems used in the current study facilitated further development of his communication.

In addition to the students' interest in the iPad device, the instructors indicated a preference within the social validity survey. The reasons for this preference included: (a) ease of use, (b) less time in preparation, (c) fewer materials required for implementation, and (d) students' increased speed in communication. The teachers reported that they would rather use a system such as the iPad than a picture communication system, because of its ease of implementation.

Several students in the current study appeared to find the iPad appealing, and teachers reported a preference. However, this study did not show that one AAC system was clearly better than the other. The differences between the two systems may offer benefits, but they may also detract from communication. For most students, the picture cards were exchanged or placed onto sentence strips, which requires more effort than touching the iPad; however, there are challenges associated with touching pictures because there may be less opportunity for gaining the communication partner's attention compared to using eye contact and being persistent. These behaviors may be taught in a more naturalistic way when exchanging cards. Another issue that was brought to light in the current study was the procedure for activating 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 problems with activation have been acknowledged (Sennott & Bowker, 2009) and attempts have been made to address them through teaching interventions (Kagohara et al., 2010). In this respect, the picture system may be advantageous because these problems would be avoided.

Limitations and Future Research

This study was limited in that the two AAC systems were compared within a single context, in which opportunities for communication were constrained by the structured snack routine. Only one communication behavior, requesting, was addressed. In addition, the study took place within a university sponsored extended school-year program rather than a typical school setting. It is not known whether the latter would lead to similar findings. Future research should investigate the use of devices such as the iPad within typical school settings. Furthermore, future research should investigate other commercial applications that have since become available for the iPad.

The setting for the study was another limitation. The study took place within the context of an extended school year program that lasted 5 weeks. Due to the time required to obtain informed consent from parents and days

lost due to student absences, there were time constraints that affected data collection. Decisions regarding phase changes were often made with time limitations in mind. The researchers acknowledge that differences in data across the conditions may have been more apparent had the students been available for a longer study period.

Another limitation of this study was that the participants had already mastered requesting behaviors and were skilled users of a picture system for requesting. Although some of the students' communication behaviors increased when using the iPad, it is not known whether the two methods differ when users are learning how to use AAC systems for communication. Future research should address this by comparing picture-based systems and the iPad in situations in which students acquire basic communication behaviors. Further research should also investigate skilled AAC users' communication across settings and contexts, given different types of devices. For example, it is not known whether social interactions might differ when using a picture-based system or SGD such as the iPad.

Finally, it is not known whether one type of symbol set (photographs for the iPad condition and Boardmaker symbols for the pictured-based condition) may have been preferred over the other. Future research should use the same type of graphic symbol when comparing devices.

Conclusions

The findings indicate the use of the iPad did not detract from students' communication. Communication behaviors either increased with the use of the iPad or remained at the same frequency as when using the picture-based system. Although this is a preliminary study, the iPad was a viable communication alternative to the picture system for the snack-time activity. Both systems require programming and explicit instruction in order for students to successfully use them as AAC systems. Once this is established, the iPad may offer an advantage in terms of amount of work associated with implementation compared to a picture-card system, which requires preparation of picture cards, storage, and movement from place to place. The iPad can be easily moved from one activity to another with no teacher preparation beyond initial programming of the device. For this reason, the instructors in this study preferred using the iPad over the picture system. Educators and families might prefer a system such as the iPad because of this convenience.

Accessibility is another advantage of the iPad over other SGDs in terms of cost and availability to the general public; however, it is not clear whether the iPad and other more accessible technologies are better than more costly SGDs. It is important to consider that the resources saved by investing in devices such as iPods, iPads, or other devices may be more costly in the end if they do not result in effective and efficient communication. As discussed previously, the procedures for activating the iPad are problematic and highlight the challenges of using devices that are not specifically designed for use as an AAC system. Further research is needed to assess the utility of the iPad and similar tablet devices across individuals and settings as well as in comparison to other SGDs. Much research is needed before concluding that the iPad and similar alternative devices will be a cost effective alternative to current SGDs.

Notes

1. Proloquo2go (Version 1.6) [computer software]. Amsterdam, Netherlands: AssistiveWare.
2. iPhone, iPod Touch, and iPad are registered trademarks of Apple Inc. Cupertino, CA.
3. Boardmaker is available from Mayer-Johnson, Pittsburgh, PA.
4. HP iPAQ Mobile Media Companion is a registered trademark of Hewlett-Packard Development Company, Palo Alto, CA.

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Appendix A

Social Validity Questionnaire Items

Items Given Prior to Intervention

There is a need for an AAC system (picture system or SGD) for my students during snack.

True Somewhat True Somewhat False False

My students would benefit from an SGD for communication during snack time.

True Somewhat True Somewhat False False

I would be interested in using an iPad as an SGD for communication during snack time.

True Somewhat True Somewhat False False

I have had prior experience using an SGD for communication.

True Somewhat True Somewhat False False

Use the lines below to describe your past experiences with SGDs for communication, including iPad, iPhone, iPod Touch etc…

_____

_____

Items Given After Intervention

My students' communication behaviors during snack increased when using the iPad.

True Somewhat True Somewhat False False

My students' communication behaviors during snack were the same regardless of the communication tool (iPad or Picture-system).

True Somewhat True Somewhat False False

The iPad was easier for me to use during snack than picture-system.

True Somewhat True Somewhat False False

The iPad was easier for my students to use during snack than the picture-system.

True Somewhat True Somewhat False False

My students were faster in their communication when using the iPad.

True Somewhat True Somewhat False False

(*Continued*)

My students liked using the iPad more than using the picture system.

True Somewhat True Somewhat False False

If I could choose a communication tool for my students, I would choose an iPad over the picture system.

True Somewhat True Somewhat False False

Using the iPad was beneficial for my students.

True Somewhat True Somewhat False False

Using the iPad was beneficial for my students.

True Somewhat True Somewhat False False

I would recommend using the iPad to other teachers

True Somewhat True Somewhat False False

Use the lines to below to describe your experience with using the iPad with students in your classroom.