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ORIGINAL ARTICLE

Comparing Teacher and Student Use and Preference of Two Methods of Augmentative and Alternative Communication: Picture Exchange and a Speech-Generating Device

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Abstract Handheld computing technologies such as the iPad®, which can be adapted to function as a speech-generating device, has led to an influx of evolutions comparing modalities of Augmentative and Alternative Communication systems (AAC) in the acquisition of a mand (i.e., request) repertoire in children with autism and related developmental disabilities. While these studies have consistently yielded results indicating equal acquisition across picture-based systems (PE) and the SGD, they have demonstrated a primary preference for the SGD. The purpose of this study was to extend such research by comparing not only student acquisition and preference, but also stakeholder fidelity of use and preference. Using an alternating treatment design, teachers and paraprofessionals were instructed to conduct mand training trials using both a PE system and an iPad® Mini with the application Proloqu2Go™ as a SGD, with seven school aged children with a diagnosis of autism or downs syndrome. Following 10-weeks of data collection, the student participants were exposed to a device preference assessment and teachers completed a social validity questionnaire to assess preference. The results were consistent with previous research indicating equal acquisition and fidelity of use across both devices; but a general preference for the iPad® based SGD.

Keywords iPad · Mand · Autism · Speech-generating device

Introduction

It is estimated that 30 % of individuals with a diagnosis of autism lack the ability to communicate using vocal speech (Wodka et al. 2013). For those individuals educational

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and clinical best practice dictates the use of an Augmentative or Alternative Communication system (AAC; Mirenda 2001). Many AAC systems exist and include manual sign language, picture based communication (PE), and the use of a speech-generating device (SGD; Mirenda 2001, 2003). Recently, we have seen an increase in the use of SGD in educational and clinical practice, as handheld computing devices such as the iPad® can be adapted to function as a SGD when outfitted with applications such as Proloqu2Go™ (Lorah et al. 2015). However, given the range of AAC systems that are available and the potential for an individual with a developmental disability such as autism to acquire the ability to communicate using such a device, several factors should contribute to the selection of an appropriate AAC device.

To assist in this selection, the literature has offered many comparison studies between methods of AAC. For example, van der Meer et al. (2012) compared the acquisition of a mand (i.e., request) repertoire in four children aged 4 years-to-11 years old, using an iPod® Touch as a SGD, a picture based communication system (PE) and manual sign language (MS). Using an alternating treatment design, participants were exposed to a multi-component training package that included verbal prompting, time delay prompting, graduated guidance, and differential reinforcement. The results of the study indicate that only two participants acquired the ability to mand across all three modalities. All four of the participants acquired the ability to mand using PE and the SGD. In terms of device preference, all four participants demonstrated a preference for the iPod® Touch based SGD (van der Meer et al. 2012).

Similarly, Lorah et al. (2013) compared the acquisition and device preference across PE and an iPad® SGD, in five preschool aged males with a diagnosis of autism. Using an alternating treatment design, participants were exposed to a mand training procedure that used a five-second-time delay with full-physical prompts. Additionally, a device preference assessment was conducted, during which participants were offered the ability to mand using either device. The results of the study indicated that for four of the participants, the use of the iPad® based SGD produced higher rates of manding, while PE produced higher rates of manding for one participant. In terms of device preference, the iPad® SGD was preferred by four of the five participants and PE was preferred by one participant (Lorah et al. 2013).

More recently, McLay et al. (2016) compared the acquisition, generalization, maintenance, and preference of a mand repertoire, across three methods of AAC: PE, MS, and an iPad Mini® SGD. The study used a multiple probe design, within an alternating treatment design and included four preschool aged children with autism. The instructional procedures included a 10-s time delay with a least-to-most prompting hierarchy. The results indicated that three of the four participants reached mastery criterion for all three-communication modalities. One participant acquired the ability to mand using PE and the SGD, but failed to acquire MS within the context of the study. Two participants demonstrated generalization of this skill across settings and people with PE and the SGD; one child demonstrated generalization using all three-communication modalities; and one child demonstrated generalization with only PE. Maintenance data indicated better results for the PE and SGD systems and the participants most often selected the iPad® Mini based SGD during the device preference assessment (McLay et al. 2016).

Although these three studies demonstrate mixed and or generally inconclusive results in terms of acquisition and performance across modalities, what is worth noting is the general preference for participants in terms of the SGD. Furthermore, in a 2015

review of the literature on the use of handheld computing technology as a SGD, Lorah et al. found that of the 19 participants included in a device preference assessment, 16 (or 84 %) demonstrated a preference for the SGD. That said, it is not known whether this preference is for SGD in general or for a tablet based SGD specifically, as there has yet to be a comparison study across different modalities of SGD. Additionally, there is a need for research that uses the teacher as the interventionist, rather than an experimenter. This would extend the literature based in terms of generalizability to natural classroom contingencies.

While participant preference for a communication device is an important consideration when selecting an AAC, a secondary consideration should be stakeholder preference and the fidelity of stakeholder use of an AAC device. In a survey of 31 professionals and 90 parents, researchers Clark et al. (2015) found that attitudes towards the use of the iPad® as a SGD were positive. Additionally, parents reported a high rate of use of these devices; alternatively, professionals reported some use as part of his or her practice. The authors concluded that in terms of professional practice, the iPad® is not being used to a degree that is consistent with his or her favorable attitude towards them (Clark et al. 2015).

Although this survey provides some preliminary evidence as to the attitudes towards the use of iPad® based SGD, there still remains to be an evaluation of teacher fidelity of use and device preference comparing methods of AAC. Thus, the purpose of this study was to a) compare teacher and paraprofessional fidelity across an iPad® Mini based SGD and a PE system; b) compare teacher and paraprofessional preference across an iPad® Mini based SGD and a PE system; c) compare student mand acquisition across an iPad® Mini based SGD and a PE system, using a teacher interventionist; and d) compare student preference across an iPad® Mini based SGD and a PE system.

Method

Participants

Teacher and Paraprofessional Participants As presented in Table 1, two teachers and two paraprofessionals participated in the study as the interventionist. All four adult participants had previous experience working with children diagnosed with autism or a

Table 1 Student participants

Name	Age	Grade	Communication	Diagnosis
Jax	11.4	4	Noise, Gestures, repeats 10 words	Downs Syndrome
Kyle	12.1	5	Echolalia Speech, noises	Downs Syndrome
Aaron	12.7	5	Noises, repeats a few words	Autism
Aiden	10.5	3	Noise, Gestures, repeats 10 words	Autism
Gabe	9.9	3	Noise, Gestures, repeats 10 words	Autism
Corey	8.5	1	Gestures	Autism
Grace	8.11	2	Gestures	Autism

developmental disability, but had limited experience, if any, using an AAC, including PE and a table-based SGD. All four adults were employed within the same publically funded elementary school and were placed within a special education classroom that contained students with special education needs. One teacher and two paraprofessionals worked within the same classroom; the remaining teacher worked in a separate classroom. Educational levels of the adult participants ranged from a high school diploma to graduate level education and teacher certification.

Student Participants As presented in Table 2, seven elementary school students, six male and one female, participated in the study. The participants ranged in age from eight-years and five-months to 12-years and one-month old. All of the participants attended the same publically funded elementary school. Two of the participants (Corey and Grace) attended a kindergarten-second grade classroom. The remaining participants attended a classroom for learners from third-fifth grade. Three of the participants were of a Hispanic descent; four of the participants were Caucasian. Five of the students were diagnosed with autism; two of the participants had a diagnosis of Down Syndrome. All seven students were selected for participation in the study by a consulting Board Certified Behavior Analyst™ who was employed by the same school district. They were selected as they were identified as meeting the following criteria: a) no history of communication training with a picture based communication system; b) no history of communication training with a tablet based speech-generating device; c) non-vocal or minimally vocal; d) had current goals that included mand training using an Augmentative or Alternative Communication system. Students were not included or excluded based on diagnosis.

Setting & Materials

The setting for the study was the self-contained classrooms in which participants received his or her primary instruction. Mand training sessions were conducted at either the students' desks or a child-sized table within the classrooms. During those sessions, the participant and teacher were seated either next to one another or across from one another, this arrangement varied and was individualized based on how the student typically received 1:1 (teacher: student) instruction. In other words, if a particular student typically received instruction with his teacher positioned across from the table that is how mand training sessions were conducted. Conversely, if a student

Table 2 Teacher participants

Name	Age	Education Level	Job Title	Years of Experience	AAC Training
Jack	41	Master's Degree	Special Education Teacher	6 Years 6 Months	None
Trevor	25	Bachelor's Degree	Paraprofessional	7 Months	None
Nancy	37	Bachelor's Degree	Special Education Teacher	1 Year	None
Amy	56	High School	Paraprofessional	3 Years 7 Months	None

typically received instruction with the teacher positioned next to him at a table or desk, this is how mand training sessions were conducted.

Picture Based Communication System During PE sessions the materials included 3 × 3 cm laminated pictures depicting one tangible item and a large Velcro picture exchange book produced by Pyramid Educational Consultants. The PE book was plastic and contained a Velcro strip on the cover, where a picture was secured during training. The pictures used were produced using the pre-loaded picture-symbols contained within the Proloqu2Go™ application. These pictures were identical to those pictures used during SGD training.

Speech-Generating Device The SGD was an iPad® Mini Generation II, loaded with the Proloqu2Go™ application. The device was covered in a LifeProof™ case during all training sessions. The pictures on the screen of the device were also 3 × 3 cm and identical to those used in the PE training sessions.

Preferred Stimuli A variety of edible and non-edible items were used during mand training. These items were selected by the classroom teacher as being the most preferred items, for each respective student participant on an open-ended preference assessment survey. The items included cookies, candy, crackers, chips, trains, time-telling flashcards, play-dough, and cars. During mand training sessions five individualized and preferred items were present and in view of the participant.

Experimental Design

This study used an alternating treatment design (Gast and Ledford 2014). PE and SGD training sessions were presented in a random order across the seven participants and included a near equal number of training sessions across each device. Following 10-weeks of data collection, a device preference assessment was conducted. Though preferred, it was impossible to ensure an equal distribution of training sessions across modalities due to student absences and the end of the school year.

Dependent Measure & Measurement System

During all sessions, frequency data were collected on independent and prompted mands. This was subsequently converted to a percentage of independent mands, by taking the number of independent mands and diving it by the total number of opportunities to mand, multiplied by 100. Trials to criterion were calculated post-hoc. During Phase I of PE training, an independent response was documented if the participant selected the picture corresponding to the targeted item from the cover of the communication book and exchanged that picture by handing it to the listener/teacher. During Phase I of SGD training, an independent response was documented if the participant selected the picture corresponding to the targeted item, on the screen of the SGD, with enough force to evoke the digitized voice output. During Phase II (discrimination between pictures) of both PE and SGD training an independent response was documented if the participant competed the steps as outlined and they selected the same item for which they manded during a correspondence check.

General Procedures

This study evaluated teacher and student use and preference for two methods of Augmentative and Alternative Communication: Picture Based and an iPad® based SGD. Thus, classroom teachers and classroom paraprofessionals conducted all mand-training sessions with the student participants. Therefore, the first step in the procedures was to provide the teachers and paraprofessionals with information and training on implementing mand training across both AAC modalities. Once it was determined that the teachers were sufficiently trained (i.e., he or she indicated comfort with the procedures and demonstrated the procedures to a mastery criteria of 100 % fidelity) using both device, mand training was implemented.

Teacher Training Teacher training was conducted in three phases. The first phase involved an initial description of the study and the importance of mand training. The second phase involved a job aid that described the phases of the study and a description of what a mand training trial entailed. Finally, modeling and teacher demonstration with feedback was conducted and continued until teachers demonstrated the ability to complete the following steps at 100 % accuracy: a) contrive a mand; b) present the device with the correct field of pictures; c) reinforce manding and prompt manding using the teaching procedures; d) collect data; e) implement a correspondence check. This training lasted for an average of five demonstrations across all teachers (range, 1–7). In-vivo training also occurred during procedural fidelity checks. If a teacher made an error during fidelity checks they were told what the error was, how often the error occurred during a session, and the correct implementation of the step was modeled. Finally, during 31 % of all manding sessions, distributed evenly across both devices, the primary investigator was present and collected procedural fidelity data to determine the degree to which the procedures were being followed with accuracy. During these sessions, the primary investigator collected yes/no probe data for each trial on the following teacher behaviors: a) follow the student EO; b) correctly contriving a mand; c) the correct device is present; d) the correct field size is presented; e) appropriate prompting procedures are used; f) correspondence check was implemented correctly; and g) accurate data were collected. The results of the procedural fidelity checklists are presented in Table 3.

Table 3 Teacher fidelity of implementation

	Jack		Nancy		Tyler		Amy	
	PE	SGD	PE	SGD	PE	SGD	PE	SGD
Contrive Motivation	100 %	96 %	100 %	100 %	100 %	96 %	100 %	98 %
Correct Prompt	100 %	96 %	100 %	100 %	100 %	85 %	99 %	98 %
Implementation of Correspondence Check	97 %	95 %	100 %	100 %	N/A	N/A	100 %	92 %
Correct Field Size	99 %	100 %	100 %	100 %	90 %	100 %	99 %	98 %
Accurate Data Collection	100 %	100 %	100 %	100 %	85 %	100 %	100 %	97 %

Mand Training Each mand training session consisted of 10 individual manding opportunities, or trials. During these sessions, the teacher sat either next to or across from the student as described previously. Next an in-vivo preference assessment was conducted, where the student was presented with three preferred items. The item that the student reached for was used as the target item for a respective trial. That item was kept within view, but out of reach and the corresponding AAC device was placed directly in front of the participant, with a field of one picture either on the screen of the device or on the cover of the communication book. If the participant independently manded for the item they were granted access to the item for either 30-s or until complete consumption of the item, as was the case with edible items. If the participant began to make an error, or if a latency of five-seconds passed without the participant initiating a response, a full-physical prompt was used to evoke correct responding, and that response was reinforced accordingly. Thus, the procedures included a five-second-time delay with full-physical prompts. For phase one of SGD training, a field of one-picture, which took up the entire screen of the device, was used. For phase one of PE training, one picture, secured to the communication book was used.

The student participants acquired the ability to mand with a field of one picture on the screen of the device and/or on the cover of the communication book quickly. A mastery criterion of five sessions at or above 90 % independent was used to determine mastery of Phase I. A second phase of mand training was introduced during which discrimination between the pictures on the screen of the device and/or cover of the communication book was implemented. During Phase II of training, the screen of the SGD and/or the cover of the communication book contained four pictures of preferred items/activities (Lorah et al. 2015). During this phase, correspondence checks were used to determine the accuracy of independent mands. A correspondence check consisted of the teacher holding up two preferred items, including the item manded for and followed by the utterance “take it”. If the student selected the same item for which they manded, the trial was scored as accurate. If the student selected the distractor item, he or she was prompted to mand for that item using a full-physical prompt, no other prompting occurred. Correspondence checks were performed during each mand within Phase II.

Mand training sessions, for both the SGD and PE communication systems, continued in this manner until 10-weeks of data collected had passed. Following 10-weeks of data collection a participant device preference assessment was conducted by the author and the teachers completed a device preference survey. The decision to collect data for 10-weeks was made as it corresponded with the end of the school year.

Device Preference Assessment To assess student device preference participants were presented with the opportunity to mand (as outlined in the procedures), however both devices were present. The locations of the devices were changed (i.e., from the right of the participant, to the left of the participant) after each trial to control for possible hand dominance. Ten preference trials were conducted per session, with three sessions occurring per student participant. Additionally, the primary investigator implemented the device preference assessment to control for any influence teacher device preference may have had. To assess teacher device preference they were given a questionnaire to complete following the conclusion of data collection. The questionnaire contained questions evaluating: how comfortable they were with using each modality; how likely

they were to use each modality in the future; how likely they were to recommend each modality; and how easy they found each modality to use. Additionally, they were asked which communication training strategy they preferred.

Procedural Fidelity

Procedural fidelity was ensured in two ways. First the mand training procedures were included on the bottom of the data collection sheet. Thus, teachers always had the procedures available to them during sessions. Second, a procedural fidelity checklist was completed by teachers following each mand training session. This checklist included the following areas: a) following the training steps as outlined; b) having the correct device present; c) following the correct reinforcement/prompting procedures; and d) collecting accurate data. Completion of the checklist indicted that teachers followed the procedures, as outline, for 100 % of the mand training trials across both AAC modalities. Finally, during 31 % of all manding sessions, distributed evenly across both devices, the primary investigator was present and collected procedural fidelity data to determine the degree to which the procedures were being followed with accuracy.

Interobserver Agreement

Interobserver agreement (IOA) data were collected during 31 % of all training sessions, and were distributed evenly across both devices. IOA data were calculated by dividing the number of agreements, by the number of agreement plus disagreements, multiplied by 100. IOA was 99 % for the SGD and 96 % for PE. Additionally, IOA data were calculated for 100 % of the student device preference assessment. IOA data were calculated identical to the mand training sessions and were 100 % for all participants. The primary investigator of the research collected IOA data.

Results

Student Results

Aaron As depicted in Fig. 1, Aaron was exposed to 14 training sessions across both devices. He reached mastery criteria for Phase I with the SGD after five sessions and for PE after nine sessions. He averaged 98 % (range, 90–100 %) independent and accurate responding for Phase I with the SGD and 93 % (range, 70–100 %) for PE. For Phase II, Aaron averaged 98 % (range, 80–100 %) independent and accurate responding with the SGD and 100 % with PE. In terms of overall average and independent responding, Aaron averaged 98 % with the SGD and 96 % with PE. Thus, there were no significant differences between these two devices with regard to acquisition. However, during the device preference assessment, Aaron demonstrated a clear preference for the SGD, using it for an average of 97 % (range, 90–100 %) of trials.

Kyle As depicted in Fig. 2, Kyle was exposed to 13 training sessions across both devices. He reached mastery criteria for Phase I with the SGD after five sessions and

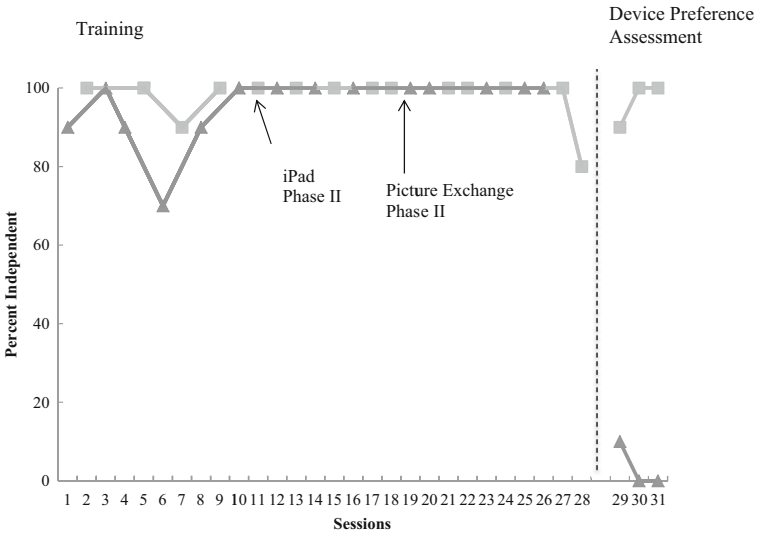

Fig. 1 Aaron percent of independent manding. This figure depicts Aaron's percentage of independent manding across the iPad Communication System and the Picture Based Communication System during training and the device preference assessment. The symbol *arrow* indicts the introduction of Phase II, for each respective device

for PE after eight sessions. He averaged 100 % independent and accurate responding for Phase I with the SGD and 89 % (range, 60–100 %) for PE. For Phase II, Kyle averaged 96 % (range, 90–100 %) independent and accurate responding with the SGD and 92 % (range, 80–100 %) with PE. In terms of overall average and independent

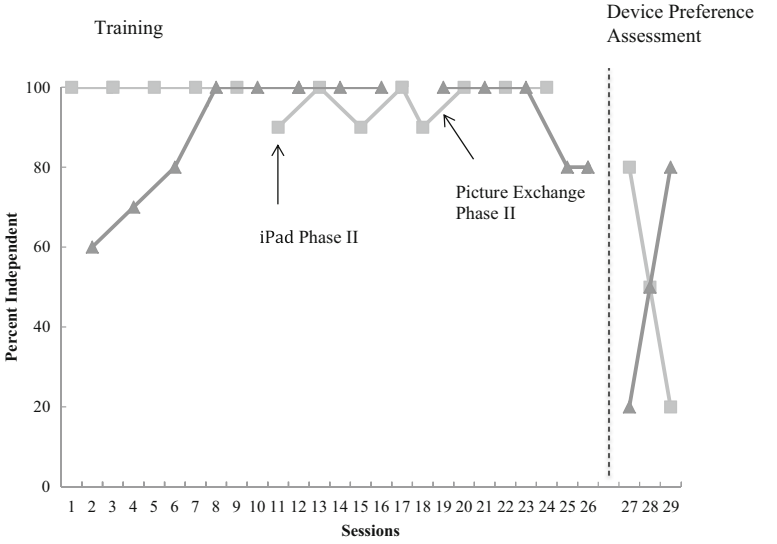

Fig. 2 Kyle percent of independent manding. This figure depicts Kyle's percentage of independent manding across the iPad Communication System and the Picture Based Communication System during training and the device preference assessment. The symbol *arrow* indicts the introduction of Phase II, for each respective device

responding, Kyle averaged 98 % with the SGD and 90 % with PE. Thus, there were only slight differences between these two devices with regard to acquisition. This remained consistent within the preference assessment where Kyle did not demonstrate a clear preference, using the SGD and PE for an average of 50 % (range, 20–80 %) of trials.

Jax As depicted in Fig. 3, Jax was exposed to 14 training sessions with the SGD and 13 training sessions with PE. He reached mastery criteria for Phase I with the SGD after eight sessions and for PE after 10 sessions. He averaged 95 % (range, 60–100 %) independent and accurate responding for Phase I with the SGD and 90 % (range, 70–100 %) for PE. For Phase II, Jax averaged 100 % independent and accurate responding with the SGD and 93 % (range, 80–100 %) with PE. In terms of overall average and independent responding, Jax averaged 97 % with the SGD and 91 % with PE. Thus, there were no significant differences between these two devices with regard to acquisition. However, during the device preference assessment, Jax demonstrated a clear preference for the SGD, using it during 100 % of trials.

Aiden As depicted in Fig. 4, Aiden was exposed to 14 training sessions for the SGD and 12 training sessions for PE. He reached mastery criteria for Phase I with the SGD after six sessions and for PE after seven sessions. He averaged 92 % (range, 70–100 %) independent and accurate responding for Phase I with the SGD and 93 % (range, 70–100 %) for PE. For Phase II, Aiden averaged 100 % independent and accurate responding with the SGD and with PE. In terms of overall average and independent responding, Aiden averaged 97 % with the SGD and 96 % with PE. Thus, there were no significant differences between these two devices with regard to acquisition.

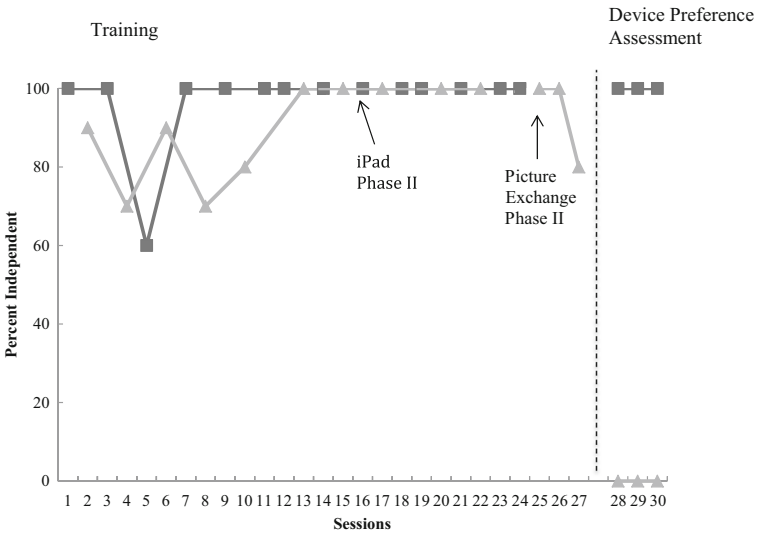

Fig. 3 Jax independent manding. This figure depicts Jax's percentage of independent manding across the iPad Communication System and the Picture Based Communication System during training and the device preference assessment. The symbol *arrow* indicts the introduction of Phase II, for each respective device

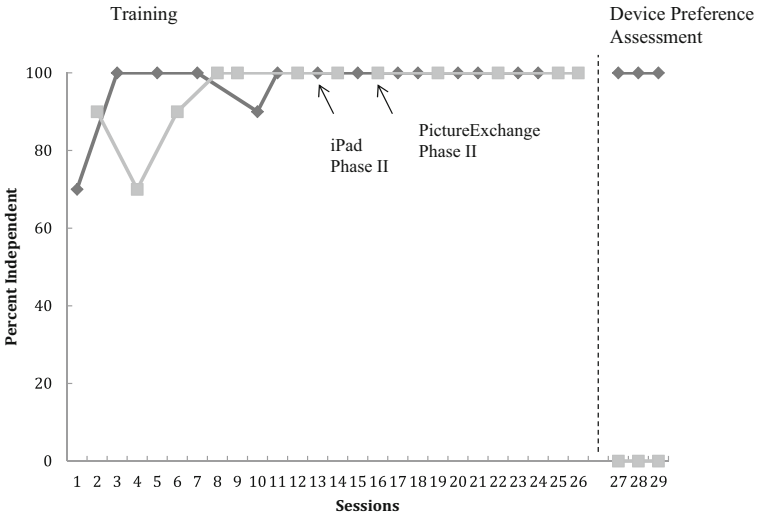

Fig. 4 Aiden independent manding. This figure depicts Aiden's percentage of independent manding across the iPad Communication System and the Picture Based Communication System during training and the device preference assessment. The symbol *arrow* indicts the introduction of Phase II, for each respective device

However, during the device preference assessment, Aiden demonstrated a clear preference for the SGD, using it for 100 % of the trials.

Gabe As depicted in Fig. 5, Gabe was exposed to 13 training sessions across both devices. He reached mastery criteria for Phase I with the SGD after seven sessions and for PE after eight sessions. He averaged 87 % (range, 40–100 %) independent and accurate responding for Phase I with the SGD and 94 % (range, 80–100 %) for PE. For

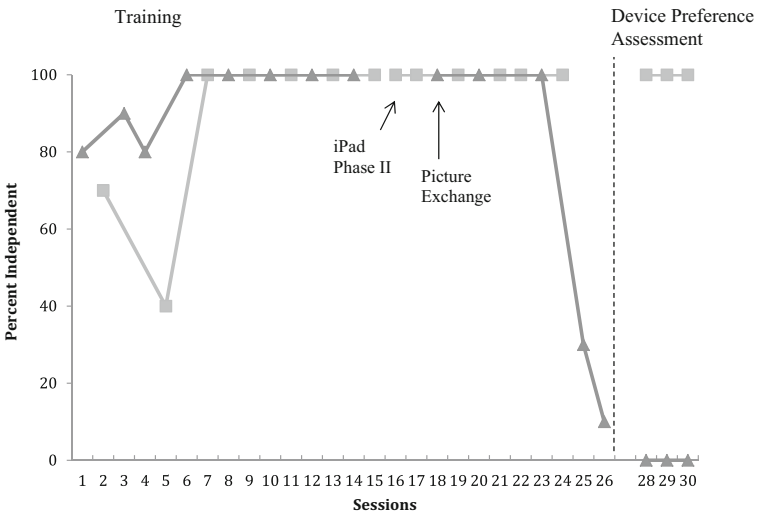

Fig. 5 Gabe independent manding. This figure depicts Gabe's percentage of independent manding across the iPad Communication System and the Picture Based Communication System during training and the device preference assessment. The symbol *arrow* indicts the introduction of Phase II, for each respective device

Phase II, Gabe averaged 100 % independent and accurate responding with the SGD and 68 % (range, 10–100 %) with PE. In terms of overall average and independent responding, Gabe averaged 93 % with the SGD and 84 % with PE, indicating slightly faster acquisition with the SGD. During session 25 there was a sharp decline in Gabe's percentage of independent manding, this may have been related to two-consecutive absences, which caused a total of four-days between communication sessions. During the device preference assessment, Gabe demonstrated a clear preference for the SGD, using it for 100 % of trials.

Grace As depicted in Fig. 6, Grace was exposed to 13 training sessions for the SGD and 15 training sessions for PE. She reached mastery criteria for Phase I with the SGD and PE after eight sessions. She averaged 76 % (range, 20–100 %) independent and accurate responding for Phase I with the SGD and 82 % (range, 40–100 %) for PE. For Phase II, Grace averaged 100 % independent and accurate responding with the SGD and with PE. In terms of overall average and independent responding, Grace averaged 85 % with the SGD and 91 % with PE. Thus, there were no significant differences between these two devices with regard to acquisition. However, during the device preference assessment, Grace demonstrated a clear preference for the SGD, using it for an average of 97 % (range, 90–100 %) of trials.

Corey As depicted in Fig. 7, Corey was exposed to 13 training sessions for the iPad and 15 training sessions for PE. He reached mastery criteria for Phase I with the SGD after seven sessions and for PE after eight sessions. He averaged 89 % (range, 40–100 %) independent and accurate responding for Phase I with the SGD and 83 % (range, 30–100 %) for PE. For Phase II, Corey averaged 53 % (range, 30–80 %%) independent and accurate responding with the SGD and 32 % (range, 10–70 %) with PE. In terms of overall average and independent responding, Aaron averaged 53 %

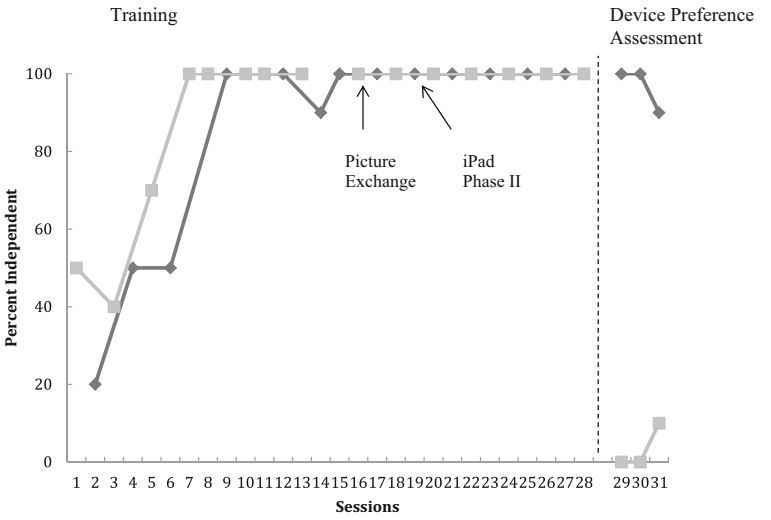

Fig. 6 Grace independent manding. This figure depicts Grace's percentage of independent manding across the iPad Communication System and the Picture Based Communication System during training and the device preference assessment. The symbol *arrow* indicts the introduction of Phase II, for each respective device

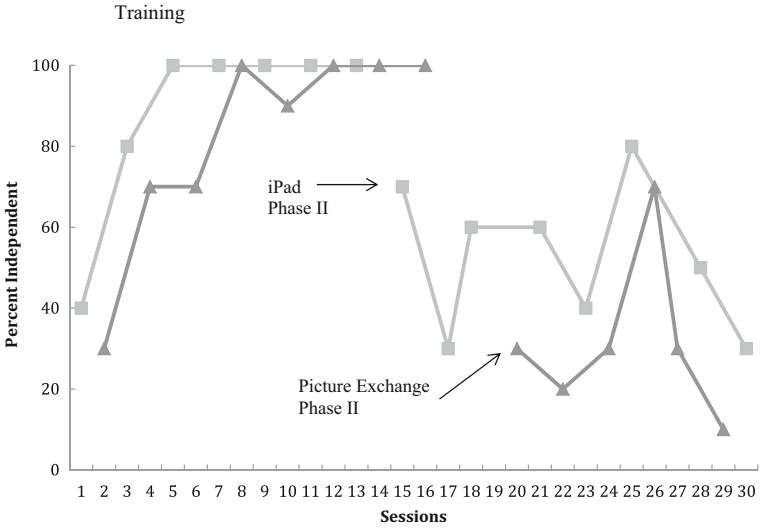

Fig. 7 Corey independent manding. This figure depicts Corey's percentage of independent manding across the iPad Communication System and the Picture Based Communication System during training and the device preference assessment. The symbol *arrow* indicts the introduction of Phase II, for each respective device

with the SGD and 32 % with PE. Thus, there was a slightly higher rate of acquisition with the SGD when compared to PE. Due to consecutive absences that coincided with the summer holiday, a device preference assessment could not be conducted with Corey.

Teacher Results

Table 3 presents the teacher implementation fidelity across all five steps of the mand training sequence, and across both the PE and SGD device. As indicted in Table 3, all four teacher-participants demonstrated a high rate of fidelity of implementation across both devices. Jack, Nancy, and Amy implanted the communication training protocol above 90 % for all steps. For PE trials, Tyler demonstrated below 90 % fidelity for correct prompting procedures and accurate collection of data. His fidelity of implantation for the SGD device was at or above 90 % for all steps in the implementation sequence. This indicates that teachers and paraprofessionals, within the natural environment can implement both the SGD and PE communication systems with a high degree of fidelity.

Social Validity Results As presented in Table 4, the social validity questionnaire presented teachers and paraprofessionals with five questions designed to compare preference and training across both PE and the SGD. Additionally, a question on training history was included. In general, teachers and paraprofessionals reported that they were "somewhat likely" to use and recommend picture-based communication in the future. They reported they were "very likely" to use and recommend iPad®- based communication in the future. They reported that they were "somewhat comfortable" using picture-based communication and "very comfortable" using iPad®-based

Table 4 Social validity questionnaire results

Picture Based Communication Training	Mean Response	Range of Responses
How did you find the training?	5- Somewhat Informative	3-Minimally Informative 7- Very Informative
How comfortable are you with using this strategy?	5- Somewhat Comfortable	3-Minimally Comfortable 7-Very Comfortable
How likely are you to use this strategy in the future?	5- Somewhat Likely	1- Not Likely 7- Very Likely
How likely are you to recommend this strategy in the future?	5- Somewhat Likely	1- Not Likely 7- Very Likely
How easy did you fine using this strategy of communication?	6- Easy	3- Requires Some Effort 7- Very Easy
How much experience did you have with this strategy?	2- Little Experience	1- No Experience 3- Little Experience
iPad® Based SGD	Mean Response	Range of Responses
How did you find the training?	6- Informative	5-Somewhat Informative 7- Very Informative
How comfortable are you with using this strategy?	7-Very Comfortable	Not Applicable
How likely are you to use this strategy in the future?	7-Very Likely	Not Applicable
How likely are you to recommend this strategy in the future?	7-Very Likely	Not Applicable
How easy did you fine using this strategy?	7-Very Easy	Not Applicable
Which communication strategy did you prefer?	100 % iPad	Not Applicable

communication. In terms of easy of use, the mean response was "easy" for PE and "very easy" for the SGD. When asked about training experience, teachers and para-professionals reported "little experience" with both devices. Finally, when asked "Which communication strategy did you prefer?", 100 % of respondents reported the iPad®-based SGD.

Discussion

The advent of handheld computing technologies such as the iPad® and iPod® that can be outfitted to function as a speech-generating device (SGD) when loaded with applications such as Proloqu2Go™, is changing the use of Augmentative and Alternative Communication systems (AAC) in clinical and educational settings for autism treatment. SGD, which were once costly and difficult to operate, are now becoming more readily available for use (Lorah et al. 2015). As such, the literature on these devices is experiencing a renewed interest in comparisons of AAC.

While there have been several studies comparing these new technologies to other methods of AAC (Flores et al. 2012; van der Meer et al. 2012; Lorah et al. 2013; Couper et al. 2014; Achamadi et al. 2012; McLay et al. 2016) those results have been generally inconclusive in terms of a comparison of new SGD to picture-based systems

(PE). That said evaluations of participant device preference have produced consistent evidence that handheld computing technologies are the preferred method of communication for the vast majority of participants. Given the heterogeneous nature of children with autism and developmental disabilities, this result cannot be overlooked.

The purpose of this study was to extend the evidence base comparing AAC methods in three ways. First was the use of the teacher as the interventionist. The majority of research this far has used an investigator associated with the evaluation as the interventionist. Thus, the current study allows us to determine if the results generally seen in previous evaluations are generalizable to a more natural instructional context. The results of the investigation were affirmative. That is, not only did the teacher-participants demonstrate high rates of implantation fidelity, but also given the rates of student-participant acquisition, it is clear that these practices can easily translate into use with teachers as the interventionist.

Secondly, this study included an evaluation of teacher fidelity of use and device preference. This is an important consideration as it is the stakeholders who ultimately control how and when an AAC device is used, through instructional practices and general availability. Stakeholder investment in the communication modality is essential to the acquisition of a communication repertoire. Given the relatively equal fidelity of implementation across both the PE and SGD device, there is little conclusion that can be drawn in terms of a comparison between the PE and SGD devices. That said, as indicated by the social validity questionnaire, teachers preferred the use of the iPad® as a SGD, when compared to the PE system. This is not unlike previous research that has offered a comparison of student use and preference across these two devices (Lorah et al. 2015).

Finally, this study used participants beyond the diagnostic scope of autism. It is evident that while these devises have received much attention in the literature base for use with individuals who have a diagnosis of autism, there is additional research necessary to expand its use to include other diagnostic categories. This further extends the literature in terms of the use of these devices beyond autism treatment.

Regarding student-participant acquisition and preference, the results of this study were no different than those previously described (Lorah et al. 2015). In terms of the student acquisition of a mand repertoire, there was relatively equal acquisition across both devices. Additionally, regarding teacher fidelity of device use, there was no significant difference between the two devices. That said, these results provide additional evidence that the iPad® based SGD was generally more preferred than the use of a PE system. Finally, in terms of teacher/paraprofessional preference, the iPad® was the preferred method of communication for all four of our participants.

While it is acknowledged that comparison studies present limitations (Johnson 1988), the result of this evaluation has an important consideration for clinical and educational practice. The marked preference for the SGD when compared to PE for both students and teachers/paraprofessionals is a significant finding of this study. It remains unknown whether the consistently found preference for SGD is related to the SGD itself or the use of these highly sought after consumer technologies. The preference for a table based SGD could be entirely related to the fact that the iPad® is an attractive and fun consumer device. What is interesting is that this preference extends beyond student use and stakeholders also prefer these devices. This remains an important finding because technologies that are liked will be used (Lorah et al. 2015).

Limitations and Recommendations for Future Research

While the research findings here are significant, this evaluation is not without limitations. First was that baseline data were not collected. While the collection of baseline data is not a requirement for the use of an alternating treatment design (Gast and Ledford 2014), the collection of such data tends to enhance the results of the evaluation. Second, was the lack of inclusion of a generalization and maintenance measure within the research design. The inclusion of a comparison of generalization and maintenance across AAC devices continues to be a consideration within the literature. Finally, the inclusion of a standardized preference assessment such as the Multiple Stimulus Without Replacement (MSWO) would have enhanced the design.

Despite these limitations, the results of this investigation are consistent with previous literature comparing handheld computing technologies as a SGD. If offers an important extension of the literature in terms of the use of a teacher interventionist and inclusion of a measure of teacher preference between PE and an iPad® based SGD.

Compliance with Ethical Standards

Ethical Approval All procedures performed in studies involving human participants were in compliance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Conflict of Interest Elizabeth R. Lorah declares no conflict of interest.

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