Can an iPad app promote educational team communication and child use of pictures in communication?

Honors Research Thesis

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ABSTRACT

Last year an iPad application named Citra was developed by an interdisciplinary group of students at Ohio State. Citra was designed for persons with severe communication disorders, such as Autism Spectrum Disorder (ASD) or Down syndrome, with the knowledge that such limits in communication greatly impact a person's ability to meet their basic needs. For example, it is estimated that 33 to 55% of children with ASD will never develop effective spoken communication (Cafiero & Meyer, 2008). Although augmentative and alternative communication (AAC) methods have been found to be especially beneficial for individuals with such severe communication disorders, only recently have AAC methods been implemented using widely available technology such as the iPad. As a type of AAC, Citra utilizes visual stimuli to support communication and to connect the child's caregiver team through a notes-sharing feature. The purpose of this research project is to employ two methods to examine the initial acceptance, use, and effectiveness of the Citra iPad application for two children with severe communication disorders. First, each child's family and speech therapist completed four questionnaires across a 9-week interval to examine their perceptions of Citra's usefulness and the child's general experience with Citra. Second, in order to compare effects of digital versus non-digital formats, the researcher observed each child's communication attempts using Citra versus another non-computerized form of AAC across six short snack sessions. The 9-week data collection period is currently underway; data presented in this thesis covers the first four weeks for Child 1 and the first three weeks for Child 2. From this data, preliminary results have been formed and are presented here. So far the study has found no significant difference between digital versus non-digital AAC formats. Once completed, this initial study of Citra's validity will provide a platform for additional validation efforts and make a timely contribution to research in AAC.

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INTRODUCTION AND BACKGROUND

The aim of this study was to explore the efficacy of treatment for those with severe communication disorders through the use of an iPad application named Citra. This study focused specifically on the use of Citra with children with an Autism Spectrum Disorder and Cerebral Palsy due to the known benefits of utilizing augmentative and alternative communication with these populations (Balandin, Berg, & Waller, 2006; Martin et al., 2009; Mirenda, 2003; Schlosser & Lee, 2000). To better explain the study, descriptions of Autism Spectrum Disorder, Cerebral Palsy, augmentative and alternative communication, and of the Citra iPad application are provided.

Autism Spectrum Disorder, commonly referred to as ASD, is a complex neurodevelopmental disability characterized by an early onset of social and communication impairments as well as inflexible and repetitive patterns of behavior and interests (Frith & Happe, 2005). According to the Centers for Disease Control and Prevention (2012), it is estimated that one in every 88 children born are diagnosed with ASD. Individuals with ASD exhibit a wide range of symptoms and experience varying levels of impairment severity. In fact, cognitive impairments are found in 60 to 70% percent of individuals with ASD (Fombonne, 2005; Steiner, Goldsmith, Snow, Chawarska, 2012). Basic communication skills such as speech, gestures, body language, and prosody are often impaired. Especially important for this study is the estimate that between 33 and 55% of individuals with ASD never develop communication skills sufficient enough to meet their most simple daily needs (Cafiero & Meyer, 2008).

Cerebral palsy is a broad term describing a category of non-progressive motor impairment syndromes caused by an onset of lesions or anomalies in the brain that occur during the early stages of an individual's development (Pirila, Pentikainen, Ruusu-Niemi, Korpela,

Kilpinen, & Nieminen, 2007). Individuals with cerebral palsy often experience varying degrees of disability in visual, auditory, motor, and speech function due to lesions in the cerebrum (Kamalalshile, 1975). Although cerebral palsy encompasses a wide range of symptoms, most commonly these motor impairments result in dysarthria, meaning poor speech production when the impairments affect the musculature used for speech (Pirila et al., 2007). This is because the individual cannot adequately maneuver the oral cavity to form clear consonants. As a result, the individual's speech is distorted and may be incomprehensible to most listeners. Lack of clear communication has been shown to lead to decreased socialization, increased loneliness later in life, and decreased employment in this population (Balandin, Berg, & Waller, 2006).

Because of their patterns of challenges, individuals with ASD, Down syndrome, and cerebral palsy represent a few groups of individuals with severe and profound communication disorders for whom alternative and augmentative communication (AAC) methods are frequently considered and have been found to be beneficial (Balandin, Berg, & Waller, 2006; Martin et al., 2009; Mirenda, 2003; Schlosser & Lee, 2000). According to the American Speech-Language-Hearing Association (ASHA, 2005), AAC is used "when necessary to compensate for temporary or permanent impairments, activity limitations, and participation restrictions of individuals with severe disorders of speech-language production and/or comprehension, including spoken and written modes of communicationò. Binger and Kent-Walsh (2010) define AAC as ñusing some form of communication that is designed to either supplement or replace more typical means of communication. Frequently, this means using something other than speech to communicateò (p. 3). Many forms of communication aids, then, are included in AAC. These range from no-tech options, such as gestures and pantomime, to low or high-tech options such as photographs and speech-generating devices. Improvements in speech, expressive

language, and social communication have been associated with the use of AAC approaches (Brady 2008; Harrell, 1997). Similar improvements have also been demonstrated for receptive language development and comprehension (Bondy et al., 1995).

Until recently, high-tech AAC systems have often been described as expensive, bulky, tedious to personalize, and overall difficult to program (Shane, Laubscher, Schlosser, Sorce, & Ambraman, 2012). Examples of such cumbersome devices include the speech-generating devices *Dynavox V*™ and *GoTalk*™ (Shane et al., 2012). With the onset of new, more portable technology, however, AAC is undergoing a ñsignificant paradigm shiftò to the latest gadgets (Shane et al., 2012, p.1229). Examples of these increasingly popular AAC technologies include the Apple *iPad*™, Apple *iPhone*™, and Google *Android*™. The combination of highly portable general purpose hardware and customizable software causes these devices to be unique and especially effective for purposes of AAC. Users find them relatively inexpensive, simple obtain and transport, easily accessible, and socially acceptable. Furthermore, so-called ñappsò on these devices allow users to explore a virtually limitless number of programs, some of which, like *Proloquo2go*™ and *TapToTalk*™, are designed specifically to function as AAC devices.

Citra is one such ñapp,ò functioning as a type of high-tech AAC. Designed for use on the Apple *iPad*™, Citra contains several functions to aid those with communication disorders. The purposes of Citra, which match those described as essential for improvement in communication for those with disorders (ASHA, 2012; Martin et al., 2009; National Down Syndrome Society, 2012), are as stated:

1. To unite the most common apps used during therapy, at home, and at school;
2. To use a common, standard database of picture elements across all sub-apps;

3. To provide a communication tool to document therapy status, disseminate homework assignments, communicate parent feedback, etc.;
4. To give caregivers common access to the same material to promote consistency of stimuli used in different environments.

Within Citra, basic functions include sub-apps labeled as Schedule Maker, Picture Board, Notes Log, and Profile. These sub-apps on the home page of Citra can be viewed in Figure 1. In keeping with the designated purposes as outlined above, Citra first combines the most effective and widely-used functionalities of AAC devices mentioned above, schedule-making and communication boards, onto one platform. To achieve its second purpose, repetition of images across all sub-apps promotes vocabulary learning and reinforcement of overall language. Third, Citra provides a Notes Log which allows all users to create and disseminate textual information. This includes, but is not limited to, observations on the childôs behavior, as well as questions, assignments, and recommendations regarding strategies for improving communication. Finally, to achieve the fourth purpose, the Profile function connects all the parents, teachers, therapists, and other caregivers of the same child to each other. Parents, therapists, and teachers can all have access to the same specific schedules and communication boards created especially for the person with a communication disorder, establishing an ongoing and easily accessible dialog between all caregivers. In short, Citra brings together several critical functions in order to meet the needs of those using AAC.

Figure 1. Citra home page.

Although the general media has given much attention to the potential effectiveness of *iPad*™ applications for those with communication disorders, little scientific support currently exists for AAC-like applications typically utilized by these persons in therapies and daily living (Ganz et. al., 2011; Wegner, 2012). There are many research questions, such as how these interventions affect social and academic skills of those with ASD, that remain unanswered (Ganz et. al., 2011). This lack in research is in part due to the relative newness and recent widespread availability of these technologies (Shane, et. al., 2011). Currently only two studies close to the one planned here could be identified (Flores, Musgrove, Renner, Hinton, Strozier, Franklin, & Hil, 2012; Price, 2011).

In Flores et al. (2012), five nonverbal children with ASD alternated for five weeks between communicating using physical picture cards and similarly-formatted digital stimuli on an *iPad*™ app that was created for the study. During the first, third, and fifth week sessions the

children were given laminated picture cards that attached to a Velcro strip in order to communicate with the teacher. In the second and fourth week sessions, the children were given an *iPad*™ app utilizing the same images as in the laminated copies. The study was conducted during a 15-minute snack time each therapy session for a total of 20 sessions. During this time, the number of communication behaviors, defined as initiating a request within 5 seconds of being prompted, was recorded and tabulated. At the end of the study, the number of communication behaviors between the sessions using laminated cards versus the number when using the *iPad*™ app was compared. It was concluded that communication behaviors of each child either increased or remained the same when using the *iPad*™ app. The authors, however, called for further research to assess and possibly replicate these results.

Price (2011) found results similar to those of Flores et al. (2012). She investigated whether the introduction of *iPad*™ interactive e-books would increase the reading comprehension level of those with ASD. Conducted at Oakstone Academy, a central Ohio school that serves equal numbers of both children with typical development and children with ASD, the participants included a total of 30 students with ASD in grades six to twelve. Each student was asked to read a traditional printed book text and then answer a set of comprehension questions. The set of questions was administered twice. Then the student was asked to perform the same task but by reading a different story using an *iPad*™ interactive e-book. Studentsô levels of reading comprehension were assessed before and after each assignment and then compared. It was found that the majority of studentsô assessment scores improved significantly after using the *iPad*™ and that ultimately none of the studentsô scores decreased after using the *iPad*™ e-book. These two studies are pertinent to this study in comparing the efficacy of digital versus non-digital approaches to educating and increasing the communication of those with ASD.

METHODS

Design

The two methods used in this research parallel the two aims of this study: (a) determining the ecological validity of the Citra among adult caregivers and (b) examining its efficacy in promoting picture use by child participants. Specifically, repeated questionnaires were used to assess the ecological validity of the Citra among caregivers (parents and speech-language pathologists) as they used the app over the course of the study. An ABAB single case experimental design was used to examine the effects of Citra on children's use of visual stimuli in communication over six weeks and was set up using guidelines by Byiers, Reichle, and Symons (2012). In this design, the use of physical picture cards versus the use of the Picture Board feature of the Citra app to indicate a food choice was alternated every other therapy session for a total of 6 sessions during a 10 to 15- minute snack time. The same images of the available food items were used for both conditions, ensuring that only the method for displaying and choosing options varies between the measurements of communication behaviors.

Participants

A total of five participants were recruited for this study: two children (Child 1 and Child 2), two mothers (Parent 1 and Parent 2, respectively), and one ASHA-certified speech-language pathologist (SLP). Recruitment was made through the use of flyers posted and distributed at the Columbus Speech and Hearing Center. Basic information about the two children is provided in Table 1.

Table 1. Description of child participants.

	Child 1	Child 2
Age, Gender	3 year- old male	4 year-old male
Diagnosis	Cerebral palsy	Autism
Predominant comm.	Nonverbal	Verbal
Initial AAC use	Some sign, picture cards	Some picture cards

Child 1 was a 3 year-old male with cerebral palsy. Due to motor deficiencies, he experienced severe communication impairments and was completely nonverbal throughout the time of the study. He did, however, communicate through some use of basic hand gestures, sign language, and picture cards. Child 1 participated in a program at Columbus Speech and Hearing Center described as "an opportunity for young children with language, peer interaction, and /or communication deficits to interact in a group setting and to receive individual intervention to support their success" (Columbus Speech and Hearing Center, 2013). This program involves two one-hour group therapy sessions and one half-hour individual therapy session each week. Child 1 had been involved in the JAM program for 3 months with the SLP prior to the start of the study. His mother, Parent 1, took him to each of the therapy sessions and was the most involved with his daily care.

Child 2 was a 4 year-old male with Autism Spectrum Disorder. He was verbal but used picture cards at times to supplement his communication. Child 2 also participated in the JAM program at Columbus Speech and Hearing Center, albeit at a different time than Child 1. Child 2 had been involved in the program for 2 years prior to the start of the study with the SLP. His mother, Parent 2, took him to each of the therapy session and was the most involved in his daily care.

The speech-language pathologist (SLP) had received her ASHA certification in 2007 and had been practicing at the Columbus Speech and Hearing Center as a full-time therapist for six years. She had been teaching the JAM program for 2 years prior to the start of the study. Her previous experience with AAC included use of picture cards on a daily basis with her clients as well as use of the *iPad*™ and other high-tech AAC options on a less frequent basis.

Procedure

Questionnaires

In order to assess Aim 1 of the proposed study, a total of four questionnaires were completed across a 9-week interval by all involved caregivers (Parent 1, Parent 2, and the SLP) to examine the perceived usefulness of the Citra app as well as each childôs general use of Citra. These questionnaires were designed to assess the caregiverôs perception of the quantity and quality of communication between themselves and the child at that time by asking questions related to three overarching themes: how Citra was used, how often, and how satisfied the users were with the application. Parent 1 and Parent 2 were asked to utilize Citra outside of therapy sessions and, if possible, on a daily basis, in order to adequately assess its use. The SLP was asked to use Citra during therapy during a designated snack time and, if desired, at any other time, such as to create visual schedules or use the Notes Log function.

The first questionnaire was administered before the introduction of Citra at the start of the study, and the three remaining questionnaires after the third, sixth, and ninth weeks of the study, respectively. Questionnaires were administered in person after the respective observation sessions were complete. Copies of the two sets of questionnaires that consist of initial

questionnaire, 3- and 6-week questionnaires, and follow-up 9-week questionnaire for parents and for speech-language pathologists can be found in Appendix A and Appendix B respectively.

Observations of Child Behavior

This study, as outlined previously in the second aim, sought to replicate the study done by Flores et al. (2012) as closely as possible in an effort to examine the efficacy of *iPad*™ applications in promoting picture use by child participants. The goal of the observations was to note whether there was a difference between a child's use of printed picture cards versus use of digital picture cards as presented through an *iPad*™ application.

Observations were conducted; during the individual therapy sessions of Child 1 and Child 2 at the Columbus Speech and Hearing Center, which occurred on Thursdays at 12:30 and Mondays at 3:30, respectively. The observations, as in Flores et al. (2012), were made during a 10 to 15-minute snack time. Snack time was chosen because it is ña natural time for incidental communication instruction regarding requestsò (Flores et al., 2012, p. 76). During this time, three different snack options were presented to the child by the SLP: pretzels, raisins, and fish crackers. Snacks were small in size and available for multiple requests.

Observations were made over six individual therapy sessions per child for a total of six weeks. The child used the designated type of AAC, whether physical picture cards or the Citra *iPad*™ app, to request the different snack items. The picture-based system was given to the participants to use during the first, third, and fifth sessions. The Citra *iPad*™ app was given to use during the second, fourth, and sixth sessions. The layout of snack options as available through the Citra *iPad*™ app can be viewed in Figure 2 below.

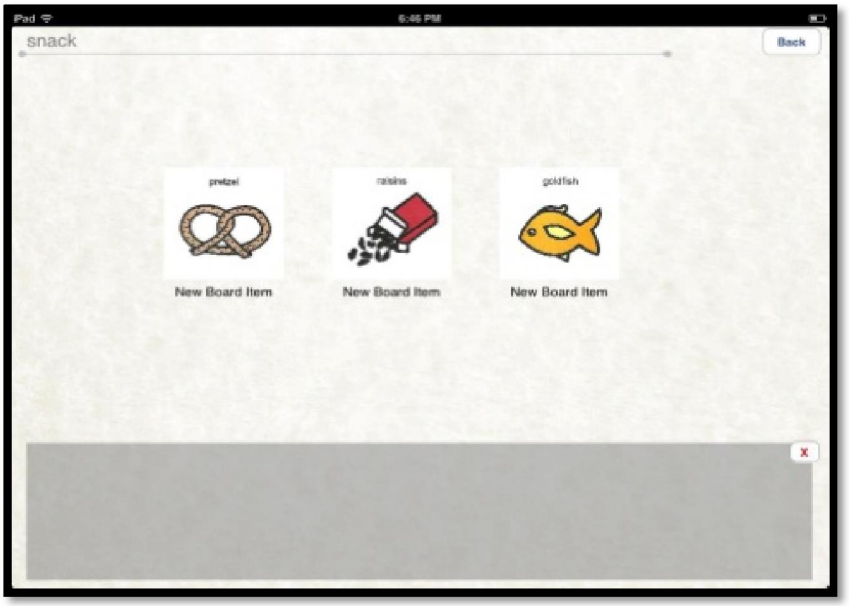

Figure 2. Layout of snack PictureBoard in Citra.

As in Flores et al. (2012), the number of communication behaviors made by the participants was observed, recorded, and displayed graphically. The number of communication behaviors made by participants on the particular type of AAC system was recorded by either the principal investigator or co-investigator. Observations were conducted from behind the one-way mirror in a room attached to the classroom, thereby reducing the possibility that the observers would influence the childôs behaviors. Each child participant had attended therapy sessions in the clinic and with the participating SLP prior to beginning the study and thus had a familiarity with the environment, SLP, and basic therapy schedule. Both child participants were accustomed to the picture-based AAC system and had general familiarity with the *iPad*™, although not specifically with the Citra app.

For the picture-based system, communication behaviors were defined as either pointing to a picture card or removing the card from its Velcro strip and placing it on the table. For the Citra *iPad*™ app, communication behaviors were defined as touching the picture on the *iPad*™ screen such that the picture moves into the sentence strip (designated by the gray area). The

application screen is presented in Figure 2. Table 2 illustrates the timing of questionnaires and observations.

Table 2. Timeline of questionnaire and observation procedures.

Week	Consent	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
Observation Session		1	2	3	4	5	6			
Observations: Condition during snack time (A, B)		A	B	A	B	A	B			
Questionnaire	X			X			X			X

Hypotheses

There were two hypotheses for this study based on the previous research and the two methods being used. First, it was expected that the questionnaires would return fairly positive results in the three areas of focus: how Citra was used, how often, and level of satisfaction with the application. Specifically, it was expected that in addition to Citra being used used for making choices during therapy snack time it would also be used in a number of other contexts, such as at home to create routines and during mealtimes. Therefore, it was expected that Citra would be used at least every other session during therapy and at home at least once a week. As the parents became more familiar with the application, it was anticipated that use of Citra would increase. Based on feedback from speech therapists and parents given during the construction of the application, level of satisfaction with the application was expected to be relatively high. For

example, it was supposed that the adult participants would deem Citra "about the same" or "more effective" when compared with other AAC options.

Based on research done by Flores, et al. (2012), it was expected that Citra use woult be associated with similar outcomes in the present study. Flores, et al. (2012) did not find a significant difference between the number of communication behaviors made using the picture cards versus the *iPad*™ application. However, they did find, that communication behaviors did not decrease with the introduction of the *iPad*™ application, which was significant because it indicated acceptance of a more efficient method by the participants who had previously used picure cards. Thus, this study, while not anticipating a major difference in number of communication behaviors between the two modes of AAC, we did expect that introduction of Citra would not decrease the number of communication behaviors being made.

Coding

Questionnaires

The questionnaires were purposely designed so that answers to most questions were presented in a multiple-choice format. Most answer choices were based on the Likert scale (Fink, 2006). For example, when considering the satisfaction level with the current AAC use, adult participants were given the choices of "very dissatisfied", "somewhat dissatisfied", "neutral", "somewhat satisfied", or "very satisfied". These predetermined answer choices were helpful to code and standardize the adult participants' responses. Once all of the questionnaires are administered, summaries within and across child-parent participants will be used as data.

Observations of Child Behavior

Results from the observation sessions were recorded throughout the study using a standardized field note form. An example of this form can be found in Appendix C. The form included empty fields for the date, participant code, investigator name, type of AAC used, and the start and finish time of snack. The number of communication behaviors was recorded using a predetermined table. This table was divided into prompted and non-prompted communication behaviors. Tallies were made in separate boxes for each time a prompted or non-prompted communication behavior was made. Prompted communication behaviors were defined as a communication behavior made immediately after the SLP asked in some form what the child would like to eat. Non-prompted communication behaviors were defined as a communication behavior made spontaneously, without the SLP asking the child what he would like. A space was provided to record vocalizations made by the child during snack time. Finally, any additional notes made during the session were recorded at the bottom of the page.

Special consideration made while coding the results for instances when the child appeared to be using the *iPad*™ application solely for play purposes and not for any communicative function. For instance, both child participants demonstrated instances of pressing a snack image repeatedly, in a way that seemed to be associated with visual stimulation seeking rather than additional request. The SLP did not respond to these play touches. Therefore, these touches on the *iPad*™ were recorded in the non-prompted communication behaviors category and were marked with the label "playing" next to them. These non-communicative touches were not counted in the final total number of communication behaviors. Total number of communication behaviors for each session comprised of the prompted and non-prompted communication behavio

PRELIMINARY RESULTS

Questionnaires

At this time only the initial questionnaires have been gathered from the adult participants of the study due to initial difficulties in participation recruitment. The initial questionnaires provide information regarding the child participants, including date of birth, diagnosis, current level of communication, and use of AAC. Adult participants were asked to identify the contexts in which AAC was used with their child prior to the start of the study and their own level of satisfaction with their current use of AAC. Finally, the adult participants were asked to give their own reasons why the child might be a good participant for the study.

Parent 1 noted use of manual signs and picture cards during morning routines, mealtimes, playtimes, bedtime routines, times running errands, and to transition between activities. She believed that participation in the study would help Child 1 to "communicate with everyone" and help him "not be frustrated with not being able to talk or speak verbally". Parent 2 did not note any use of AAC prior to the study. She said that Child 2 "sometimes has a hard time identifying his need, especially if he is excited" and that he is "is very good with a schedule". The SLP noted that Child 2 used choice boards, visual schedules, gestures, and social stories during therapy. She is "satisfied" with Child 2ôs current use of AAC, but believed the study would benefit Child 2 because he "understands use of pictures to request".

Questionnaires for weeks 3, 6, and 9 will be administered, collected, and analyzed as the study continues.

Observations of Child Behavior

Due to difficulties in participation recruitment, only seven total data points have been obtained at this time. Additional data will be collected and this document will be revised once all of the data are collected so that the results of this study can be presented in an appropriate venue (conference presentation or journal article). Four observation sessions have been recorded for Child 1 and three observation sessions for Child 2. Data collection, however, will carry on for the initially intended duration so that a total of 6 snack sessions per child participant and 4 questionnaires per adult participant will comprise the complete dataset.

Results from observation sessions for Child 1 can be viewed in Figure 3 below. During the first and third observation sessions, the child made a total of 21 and 29 communication behaviors using the picture cards, respectively. While using the *iPad*™ application, Citra, during the second and fourth weeks the child made a total of 25 and 36 communication behaviors respectively. Data has yet to be collected for the fifth and sixth observation sessions.

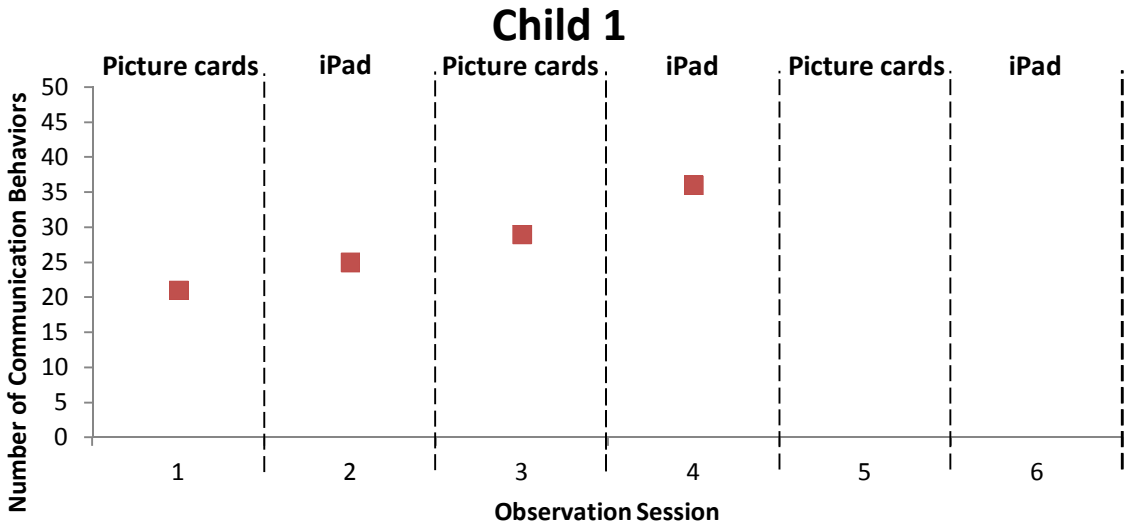

Figure 3. Preliminary results of observation sessions of Child 1.

The total number of communication behaviors can be further broken down into those that were prompted by the SLP and those not prompted. Of the 21 total communication behaviors made by Child 1 during observation session 1, 8 were prompted and 13 were not prompted by the SLP. During observation session 2, 16 communication behaviors were prompted and 9 were not. Observation session 3 showed a total of 29 communication behaviors, of which 11 were prompted and 18 were not. Finally, there were 17 prompted communication behaviors and 19 spontaneous ones for a total of 36 communication behaviors during observation session 4. Data are still being collected for observation sessions 5 and 6. These data can be viewed graphically in Figure 4 below.

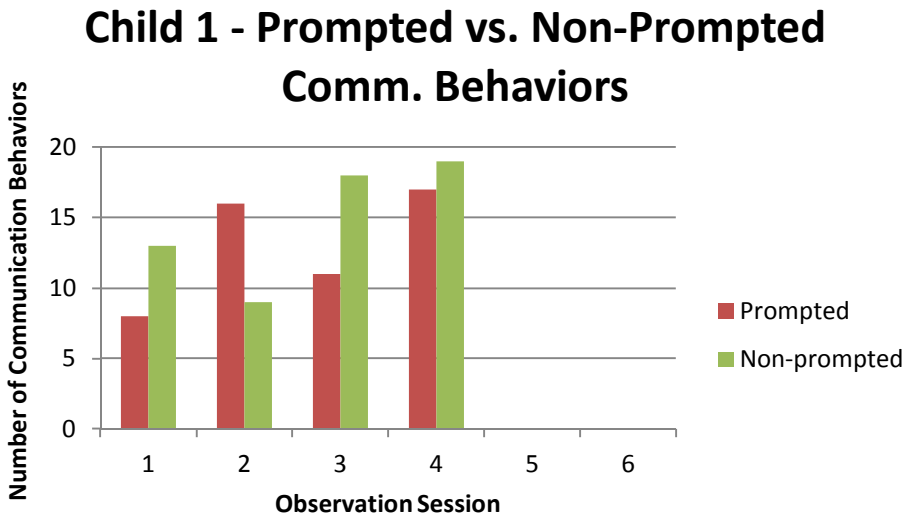

Figure 4. Number of prompted vs. non-prompted communication behaviors made by Child 1.

Results from observation sessions for Child 2 can be found below in Figure 5. During the first and third observation session using picture cards, the child made a total of 13 and 8 communication behaviors, respectively. In the second observation session, while using the Citra, the child made a total of 11 communication behaviors. Data have yet to be collected for the three final observation sessions.

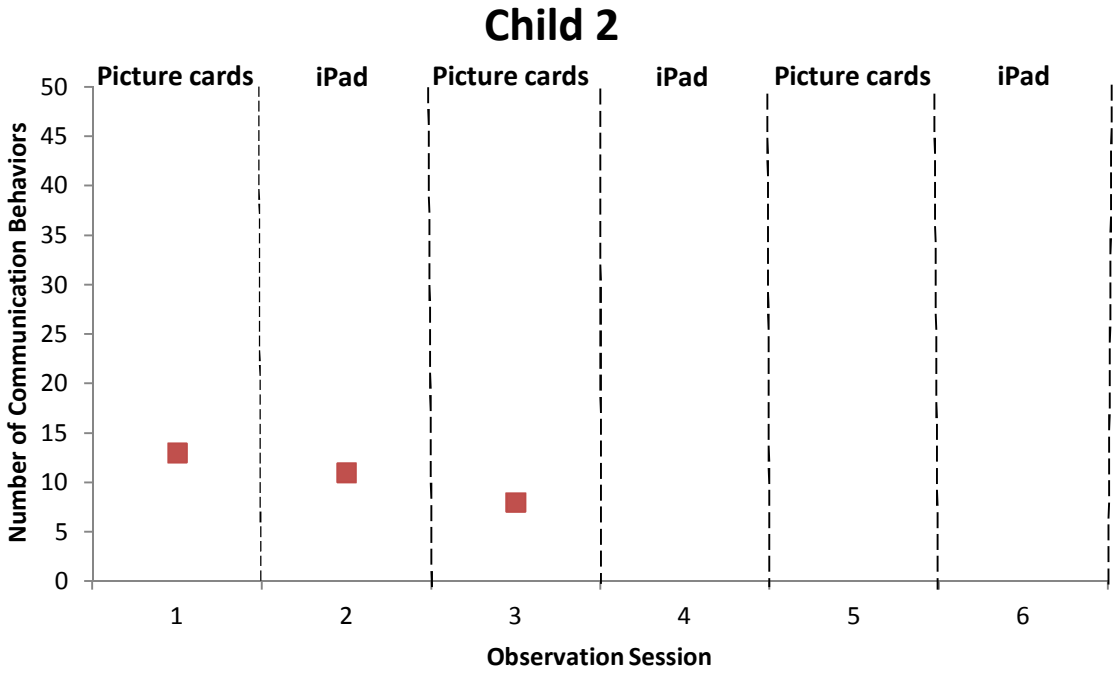

Figure 5. Preliminary results of observation sessions of Child 2.

As with Child 1, the total number of communication behaviors made by Child 2 in each of the observation sessions can be broken into two categories: those prompted by the SLP and those not prompted. During observation session 1, the child demonstrated 7 prompted and 6 non-prompted communication behaviors. Observation session 2 saw a decrease in the number of prompted communication behaviors to 3 and an increase in spontaneous communication behaviors to 8, for a total of 11 communication behaviors. All 8 of the total communication behaviors made by Child 2 in observation session 3 were prompted. Data are yet to be collected for observation sessions 4, 5, and 6. The data are presented graphically in Figure 6 below.

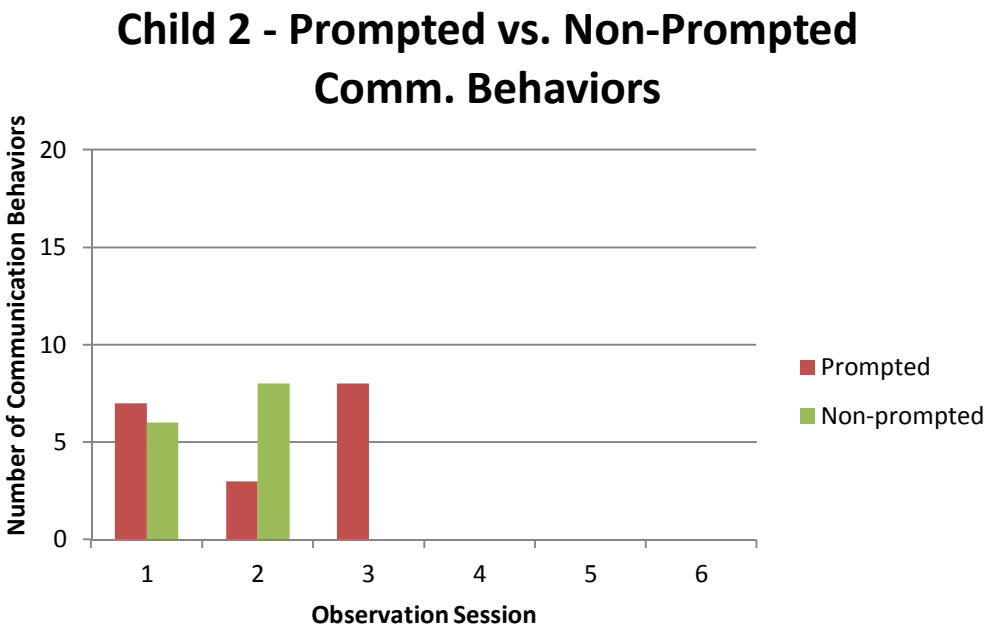

Figure 6. Number of prompted vs. non-prompted communication behaviors made by Child 2.

Reliability

Prior to the start of the study, the principal and co-investigators established common criterion for assessing communication behaviors and simultaneously assessed a staged scenario in which a research assistant acted as a child participant to examine agreement. The assistant used the Citra *iPad*™ application to make a variety of choices during a 10-minute snack time. The researchers established a point-to-point agreement of 100% over 3 trials.. In addition, 20% of the data obtained from actual observation sessions were recorded by both researchers; when agreement for these data were examined, a point-to-point agreement of 90% was obtained on the number of communication attempts in 15 minutes.

DISCUSSION

Questionnaires

The first of four questionnaires was administered to all adult participants and three remain to be completed. The information collected by the initial questionnaire garnered an in-depth background of each child participant and their use of AAC prior to the start of the study. At the conclusion of the study, direct comparison will be made for each parent/child concerning the questionnaires in these three overarching areas: in what contexts Citra is being used, how often Citra is being used, and the level of satisfaction of the adult participants with the use of Citra.

Observations on Child Behavior

The goal of this study was to replicate the study as performed by Flores, et al. (2012) and compare the results found between the two studies. The results reported by Flores, et al. (2012) can be viewed below in Figure 7. Flores, et al. (2012) reported considerable variability across the five participants. For example, Al showed a significant increase in number of communication behaviors when using the *iPad*™, while Sam and Levi did not. For all participants, however, the number of communication behaviors did not decrease when using the *iPad*™ application.

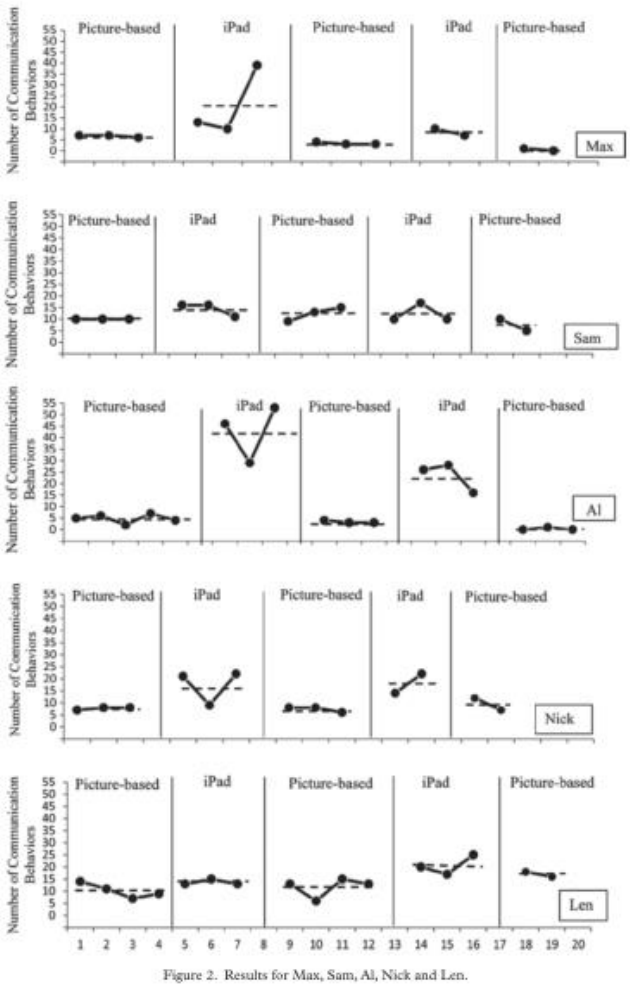

Figure 2. Results for Max, Sam, Al, Nick and Len.

Figure 7. Results as reported in Flores, et al. (2012).

In the present study, there was also a great degree in variability across the two participants. Because of the exploratory nature of this single-subject design study, visual analysis of the data were used (McReynolds & Thompson, 1983). Results for Child 1 showed the number of total communication behaviors increased each observation session despite the type of AAC used. This result did not occur for any of the participants in Flores, et al. (2012). The number of communication behaviors may have risen across observations as the child became more and more familiar with the type of AAC. In addition, Parent 1 reported giving her child a few Fig

Newton™ snacks prior to observation session 3, which may have skewed the number of requests Child 1 made during snack time.

In contrast to Child 1, results from Child 2 of this study showed a decrease in total communication behaviors for each subsequent observation session reagardless of the type of AAC used during therapy. In all sessions, Child 2 seemed passive about using the AAC methods provided and preferred instead to vocalize his choices. The SLP often directed Child 2 to using the AAC methods in addition to his voice. In all observation sessions with Child 2, there were too many vocalizations made to mark on the field notes form, thus strongly indicating his preference for vocalizing over use of the AAC intervention, which is the ultimate goal of AAC use. This might explain the low total number of communication behaviors exhibited by Child 2 during observations. In addition, it should be noted that Child 2 had eaten raisins prior to observation session 3 and therefore may not have been as hungry during snack time. In fact, Child 2 seemed uninterested in snack during observations 2 and 3, pointing out other games around the room instead. He remarked "no snack" and "I'm done" after ten minutes during observation sessions 2 and 3, respectively. This lack of interest was also reflected in the number of communication behaviors that were prompted by the SLP in observation session 3. His passivity and lack of interest in snack time during observations 2 and 3 may have greatly impacted the total number of communication behaviors during those sessions.

In the present study, we distinguished between communication behaviors that were prompted and those that were not, unlike in Flores, et al. (2012). Results showed that during observation sessions 1, 3, and 4, Child 1 exhibited more spontaneous communication behaviors than those that were prompted by the SLP. This seems to indicate that the child was engaged with the Citra application and understood its function well enough to initiate communication

with the SLP and relay his choices to her. In contrast, observations 1 and 3 for Child 2 showed a greater number of prompted communication behaviors. This may reflect the general lack of interest of the child in using the AAC methods and the SLP's continued prompting towards both AAC and vocalization.

Limitations of Current Study

The goal of this study was to replicate the study as performed by Flores, et al. (2012) as closely as possible. There were, however, several limitations that prevented the study from replicating that of Flores, et al. (2012) to the degree originally intended. The study was initially designed to record 12 total observation sessions and alternate the mode of AAC every three sessions. In this way, a baseline would have been established to provide some measure of stability between the two types of AAC used in the ABAB design and would have provided further empirical data on the validity of each intervention, therefore strengthening conclusions made (McReynolds & Thompson, 1986). This study was limited, however, because observations could only be made one time per week. In addition, the SLP was out of the clinic for several weeks and therefore observations could not be made during those times. A greater number of observation data points would have been ideal but were not possible for this particular study.

The study had originally anticipated participants to either be diagnosed with Down syndrome or a low-functioning level of Autism Spectrum Disorder. Those who responded to the recruitment flyers of this study, however, did not fit these two categories. Child 1 was an individual with cerebral palsy. Although Child 2 had been diagnosed with Autism Spectrum Disorder, he was verbal and able to communicate without the use of AAC. This study included these participants on the basis that they demonstrated severe communication disorders as a result

of their diagnoses and therefore still fit into the demographic where AAC might be beneficial (Balandin, Berg, & Waller, 2006; Martin et al., 2009; Mirenda, 2003; Schlosser & Lee, 2000). In short, however, the comparison to the Flores, et al. (2012) study to the one outlined here was greatly complicated by the nature of problems facing the two children who were recruited and thus, the appropriateness of AAC as part of their interventions.

CONCLUSION

With the onset of new, more portable technology, AAC is undergoing a significant shift to the latest gadgets, including the Apple *iPad*™, Apple *iPhone*™, and Google *Android*™. (Shane et al., 2012). The effectiveness of such technologies in interventions for those with severe communication disorders, however, has yet to be supported by empirical evidence (Ganz et. al., 2011; Wegner, 2012). This study was performed in an effort to gather this much-needed empirical evidence and to make a timely contribution to research in AAC. In addition, this initial study of Citra's validity was undertaken to provide a platform for additional validation efforts. At this point in the study (with data for 5 total sessions remaining to be collected), there appears to be no significant difference between use of physical picture cards and the *iPad*™ application when used to make choices during snack time. Once the full set of data is completed, additional conclusions will be made concerning the number of communication behaviors made and the validity of Citra as a type of AAC.

Future studies will need to be done in order to reduce the limitations experienced in this study and to provide more concrete data for the validation of using high-tech devices, such as *iPad*™ applications, as AAC devices. As McReynolds and Thonpson (1983) state, "generality of findings of single-subject research may be accomplished through replication" (202). Through

replication of Flores, et al. (2012) and this study in future research, empirical evidence may better reveal the effectiveness of high-tech AAC devices.

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Appendix A: Parent Questionnaires

A. Initial Parent Questionnaire – Items given before intervention

1. What is your childôs date of birth? _____
2. Is your child an individual with Autism Spectrum Disorder, Down syndrome, or another condition?

   Autism Spectrum Disorder Down syndrome Other: _____

3. Please describe your childôs current level of communication.

   Nonverbal Almost never verbal Somewhat verbal Mostly verbal

4. Augmentative and alternative communication (AAC) means using some form of communication that is designed to either add to or replace a more typical means of communication, usually speech. Do you currently use some form of AAC with your child?
   Yes _____ No____

   If yes, what kinds are used? Please check all that apply.

No-tech	Low-tech	Mid-tech	High-tech
__ Manual signs __ Facial expressions __ Gestures __ Pantomime	__ Drawings __ Picture cards __ Picture Exchange Communication System (PECS)	__ Choice Board __ Visual Schedules __ Social Stories	__ Speech-generating device (SGD) __ Apps of Apple *iPad*™ __ Apps on Apple *iPhone*™ __ Apps on Google *Android*™

   Other: _____

5. Using the scale below, how often do you use each of the checked AAC options?

   _____ Almost never Monthly Weekly Daily
   (Type of AAC)

   _____ Almost never Monthly Weekly Daily
   (Type of AAC)

   _____ Almost never Monthly Weekly Daily
   (Type of AAC)

   _____ Almost never Monthly Weekly Daily
   (Type of AAC)

6. In what contexts do you typically use AAC? Check all that apply.
   ___ Morning routine
   ___ To transition between activities
   ___ Mealtime/Snack time
   ___ Playtime
   ___ Schoolwork
   ___ Running errands/ Outside of the house
   ___ Bedtime routine
   ___ Other: _____
7. How satisfied are you with the current use of AAC?

   Very dissatisfied Somewhat dissatisfied Neutral Somewhat satisfied Satisfied

8. In what manner(s) do you communicate with the childôs speech therapist? How often? Please check all that apply.

___ Face-to-face	Almost never	Monthly	Weekly	Daily
___ Email	Almost never	Monthly	Weekly	Daily
___ Phone	Almost never	Monthly	Weekly	Daily
___ Other:_____	Almost never	Monthly	Weekly	Daily

9. How would you rate the amount and quality of your communication with the childôs speech therapist?

   Very dissatisfied Somewhat dissatisfied Neutral Somewhat satisfied Satisfied

   Why?
   _____
   _____
   _____

10. On what basis do you think this child would be a good participant for this study?
    _____
    _____
    _____

B. Week 3 and 6 Parent Questionnaire – Items given week 3 and 6 of intervention

1. In what contexts do you typically use Citra? Check all that apply.
   ___ Morning routine
   ___ To transition between activities
   ___ Mealtime/Snack time
   ___ Playtime
   ___ Schoolwork
   ___ Running errands/ Outside of the house
   ___ Bedtime routine
   ___ Other: _____
2. How frequently do you use Citra with your child?

   Never Less than weekly Weekly Daily

3. Which sub-app do you use the most often?
   ___ Schedule Maker
   ___ Picture Board
   ___ Notes Log
   ___ I use each sub-app an equal amount
4. How engaged does your child seem with Citra?

   Disengaged Neutral Somewhat engaged Highly engaged

5. How does Citra compare to other AAC options?

   Less effective About the same More effective Cannot tell

6. How useful do you consider the sharing feature of Citra?

   Not at all useful Not very useful Neutral Somewhat useful Very useful

7. What difference have you noticed in your childôs communication behaviors? Communication behaviors include initiations, requests, and responses.
   ___ Significant decrease in communication behavior
   ___ Slight decrease in communication behavior
   ___ No difference in communication behavior
   ___ Slight increase in communication behavior
   ___ Significant increase in communication behavior

8. In what manner(s) do you communicate with the childôs speech therapist? How often? Please check all that apply.

___ Face-to-face	Almost never	Monthly	Weekly	Daily
___ Email	Almost never	Monthly	Weekly	Daily
___ Phone	Almost never	Monthly	Weekly	Daily
___ Citra	Almost never	Monthly	Weekly	Daily

9. What improvements do you think could be made to Citra?
   _____
   _____

C. Week 9 Parent Questionnaire – Items given 3 weeks after intervention

1. How frequently do you use Citra with your child?

   Never Less than weekly Weekly Daily

2. In what contexts do you typically use Citra? Check all that apply.
   ___ Morning routine
   ___ To transition between activities
   ___ Mealtime/Snack time
   ___ Playtime
   ___ Schoolwork
   ___ Running errands/ Outside of the house
   ___ Bedtime routine
   ___ Other: _____
3. Which sub-app do you use the most often?
   ___ Schedule Maker
   ___ Picture Board
   ___ Notes Log
   ___ I use each sub-app an equal amount
4. How engaged does your child seem with Citra?

   Disengaged Neutral Somewhat engaged Highly engaged

5. How does Citra compare to other AAC options?

   Less effective About the same More effective Cannot tell

6. How useful do you consider the sharing feature of Citra?

Not at all useful Not very useful Neutral Somewhat useful Very useful

7. What difference have you noticed in your childôs communication behaviors? Communication behaviors include initiations, requests, and responses.
   ___ Significant decrease in communication behavior
   ___ Slight decrease in communication behavior
   ___ No difference in communication behavior
   ___ Slight increase in communication behavior
   ___ Significant increase in communication behavior

8. Please describe your childôs current level of communication.

Nonverbal Almost never verbal Somewhat verbal Mostly verbal

9. In what manner(s) do you communicate with the childôs speech therapist? How often? Please check all that apply.

___ Face-to-face	Almost never	Monthly	Weekly	Daily
___ Email	Almost never	Monthly	Weekly	Daily
___ Phone	Almost never	Monthly	Weekly	Daily
___ Citra	Almost never	Monthly	Weekly	Daily

10. What improvements do you think could be made to Citra?

_____

_____

Appendix B: SLP Questionnaires

A. Initial SLP Questionnaire – Items given before intervention

11. Augmentative and alternative communication (AAC) means using some form of communication that is designed to either add to or replace a more typical mean of communication, usually speech. Do you currently use some form of AAC with this client during therapy?
    Yes _____ No____

    If yes, what kinds are used? Please check all that apply.

No-tech	Low-tech	Mid-tech	High-tech
__ Manual signs __ Facial expressions __ Gestures __ Pantomime	__ Drawings __ Picture cards __ Picture Exchange Communication System (PECS)	__ Choice Board __ Visual Schedules __ Social Stories	__ Speech-generating device (SGD) __ Apps of Apple *iPad*™ __ Apps on Apple *iPhone*™ __ Apps on Google *Android*™

    Other: _____

12. Using the scale below, how often do you use each of the checked AAC options?
    _____ Almost never Monthly Weekly Daily
    (Type of AAC)

    _____ Almost never Monthly Weekly Daily
    (Type of AAC)

    _____ Almost never Monthly Weekly Daily
    (Type of AAC)

    _____ Almost never Monthly Weekly Daily
    (Type of AAC)

13. In what contexts do you typically use AAC? Check all that apply.
    ___ To establish a schedule for therapy
    ___ During therapy activities
    ___ To transition between activities
    ___ Snack time
    ___ Playtime
    ___ Other: _____

14. How satisfied are you with the current use of AAC this child?

Very dissatisfied Somewhat dissatisfied Neutral Somewhat satisfied Satisfied

15. In what manner(s) do you communicate with this childôs parents or legal guardians? How often? Please check all that apply.

___ Face-to-face	Almost never	Monthly	Weekly	Daily
___ Email	Almost never	Monthly	Weekly	Daily
___ Phone	Almost never	Monthly	Weekly	Daily
___ Other:_____	Almost never	Monthly	Weekly	Daily

16. How would you rate the amount and quality of your communication with this childôs parents or legal guardians?

Very dissatisfied Somewhat dissatisfied Neutral Somewhat satisfied Satisfied

Why?

_____
_____
_____

17. On what basis do you think this child would be a good participant for this study?

_____
_____
_____

18. Please describe your level of expertise with AAC and how often you use AAC with your clients.

_____
_____
_____

B. Week 3 and 6 SLP Questionnaire – Items given week 3 and 6

10. In what contexts do you typically use Citra? Check all that apply.
    ___ To establish a schedule for therapy
    ___ During therapy activities
    ___ To transition between activities
    ___ Snack time
    ___ Playtime

___ Other: _____

11. How frequently do you use Citra with the client?

Never Less than every other session Every other session Every session

12. Which sub-app do you use the most often?
    ___ Schedule Maker
    ___ Picture Board
    ___ Notes Log
    ___ I use each sub-app an equal amount
13. How engaged does the client seem with Citra?

Disengaged Neutral Somewhat engaged Highly engaged

14. How does Citra compare to other AAC options?

Less effective About the same More effective Cannot tell

15. How useful do you consider the sharing feature of Citra?

Not at all useful Not very useful Neutral Somewhat useful Very useful

16. What difference have you noticed in the clientôs communication behaviors? Communication behaviors include initiations, requests, and responses.
    ___ Significant decrease in communication behavior
    ___ Slight decrease in communication behavior
    ___ No difference in communication behavior
    ___ Slight increase in communication behavior
    ___ Significant increase in communication behavior

17. In what manner(s) do you communicate with the childôs parents or legal guardians? How often? Please check all that apply.

___ Face-to-face	Almost never	Monthly	Weekly	Daily
___ Email	Almost never	Monthly	Weekly	Daily
___ Phone	Almost never	Monthly	Weekly	Daily
___ Citra	Almost never	Monthly	Weekly	Daily

Can an iPad app promote educational team communication and child use of pictures?

18. What improvements do you think could be made to Citra?

_____

_____

C. Week 9 SLP Questionnaire – Items given 3 weeks after intervention

1. How frequently do you use Citra with the client?

   Never Less than every other session Every other session Every session

2. In what contexts do you typically use Citra? Check all that apply.
   ___ To establish a schedule for therapy
   ___ During therapy activities
   ___ To transition between activities
   ___ Snack time
   ___ Playtime
   ___ Other: _____

3. Which sub-app do you use the most often?
   ___ Schedule Maker
   ___ Picture Board
   ___ Notes Log
   ___ I use each sub-app an equal amount
4. How engaged does the client seem with Citra?

   Disengaged Neutral Somewhat engaged Highly engaged

5. How does Citra compare to other AAC options?

   Less effective About the same More effective Cannot tell

6. How useful do you consider the sharing feature of Citra?

   Not at all useful Not very useful Neutral Somewhat useful Very useful

7. What difference have you noticed in the clientôs communication behaviors? Communication behaviors include initiations, requests, and responses.
   ___ Significant decrease in communication behavior
   ___ Slight decrease in communication behavior
   ___ No difference in communication behavior

Can an iPad app promote educational team communication and child use of pictures?

___ Slight increase in communication behavior
___ Significant increase in communication behavior

8. Please describe the clientôs current level of communication.

Nonverbal Almost never verbal Somewhat verbal Mostly verbal

9. In what manner(s) do you communicate with the childôs parents or legal guardians? How often? Please check all that apply.

___ Face-to-face	Almost never	Monthly	Weekly	Daily
___ Email	Almost never	Monthly	Weekly	Daily
___ Phone	Almost never	Monthly	Weekly	Daily
___ Citra	Almost never	Monthly	Weekly	Daily

10. What improvements do you think could be made to Citra?

_____
_____

Appendix C: Example of completed Field Notes Form from Child 1

Can an iPad app promote educational team communication and child use of pictures in communication?

Field Notes

Date: February 28, 2013

Participant (Code): 1

Name of investigator: Sarah Singer

Start time of snack: 12:42 End time of snack: 12:57

Type of AAC used: (Circle one) Picture cards Citra 14:44.7 min

Number of Communication Behaviors:

Please tally the number of communication behaviors for both prompted and non-prompted communication trials.

Prompted Communication behaviors				Non-prompted communication behaviors			
1				1	1		
1				1	1		
1				1	1		
1				1	1		
1				1	1		
1				1			
1				1			
1				1			

21

Vocalizations:

Please quote any intelligible vocalizations made during the allotted time period.

"yummy"
"puppy"
"mmm"

Additional Notes:

- ended up pointing to box of snack instead of picture @ 10 min