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VIDEO MODELING TO INCREASE INTERACTION FOR CHILDREN WITH AUTISM SPECTRUM DISORDER IN A MUSEUM SETTING USING AN APPLICATION ON A TABLET

by

Bethany Miota

A Thesis Submitted in

Partial Fulfillment of the

Requirements for the degree of

Master of Science

in Occupational Therapy

at

The University of Wisconsin-Milwaukee

December 2016

ABSTRACT

VIDEO MODELING TO INCREASE INTERACTION FOR CHILDREN WITH AUTISM SPECTRUM DISORDER IN A MUSEUM SETTING USING AN APPLICATION ON A TABLET

by

Bethany Miota

The University of Wisconsin-Milwaukee, 2016
Under the Supervision of Professor Roger O. Smith

The purpose of this thesis was to perform an exploratory study to determine if the ScanDo! app intervention is an assistive technology that increases interaction for children with Autism Spectrum Disorder (ASD) in a museum setting. The ScanDo! app intervention presented a video demonstration that modeled the interaction for each learning station by scanning the QR code attached to the station. Using a naturally occurring baseline single-subject design with ABA and reversed ABA phases, two children with ASD and their parents visited the grocery store exhibit at a children's museum. Observers of the trials and questionnaires completed by parents before and after each trial documented play behaviors and location. We hypothesized that the intervention would increase quality interactions and length of play. Dependent variables were the location of the child and the quality of play for each ten seconds during the trial. The results showed that during the ScanDo! app intervention, both participants had a more even distribution of time spent at each station, increased transitions between stations, and decreased amount of time at stations where participants demonstrated unproductive play. These findings suggest that the ScanDo! App intervention helps

increase transitions for children with ASD to provide more learning environments and productive play opportunities.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

I would like to dedicate my thesis to my dear friend, Headmaster Magino Wilson. We worked together and were neighbors during my two years at Butebo Primary School in Uganda. He was passionate about encouraging the girl students in our community to complete their education despite the many obstacles preventing them from doing so. Wilson encouraged me to pursue my masters upon returning to the U.S. and I've thought of his support many times during the creation of this thesis. I am truly thankful for everything that he has done for me.

I would also like to thank my committee, Dr. Roger Smith, Dr. Kris Barnekow and Dr. Tom Keating. I would also like to thank my former instructor Dennis Tomashek for all of his help. Finally I would like to thank my family, specifically my parents, Mary and Paul Miota, for always teaching me the value of education and hard work.

Part I: Thesis Overview

Overview

This thesis is comprised of three parts: 1) the introduction to the thesis, 2) the research manuscript, and 3) the appendices. Part 1 consists of the introduction to the thesis and provides an overview of the entire thesis, the timeline of the study and changes that were made. Part 2 includes the research manuscript that contains sections such as literature review and discussion of the results. The manuscript was written in a general manuscript format in order to accommodate for different journals. Part 3 contains 12 appendix sections pertaining to the manuscript and overall thesis. These sections include the Proposal, Intervention Materials, Recruitment Materials, Data Collection Forms, the approved IRB and Equivalent Text Descriptions. All writing is based on APA format.

Timeline of Study

The following is a chronological summary of this study. During the summer of 2016, the primary researcher began collaborating with Samantha Davis, a UW Milwaukee student in the Masters of Science Occupational Therapy program. Davis' master's project was a guide to complete a study using the ScanDo! app as an intervention for children with Autism Spectrum Disorder (ASD) in a children's museum. Davis and the primary researcher attempted to create video models using two girls, ages 6 and 8, with a tablet and the scripts from Davis' guide to collect data for her project and begin filming for this study.

Davis' guide described a study using a control group. After consulting the committee of advisors, it was determined a single-subject design would produce more meaningful results for this study due to the variation in children with ASD.

The research proposal was presented to the committee of advisors in October, 2015. Committee members approved the research design and hypotheses (See Appendix A for full proposal).

Original documents were submitted to the Institutional Review Board (IRB) in November, 2015 (See Appendix K for full IRB). The protocol was approved in December, 2015. The IRB was amended twice after submission to change data collection methods and to acquire additional personal participant information for funding purposes, but neither had significant effects on the outcomes of this study. Funding for the study was provided through the College of Health Science Graduate Research Grant and Cognitopia. Funding allowed participants to receive compensation after two trials, allowed for creation of the intervention materials, as well as the employment of two research assistants for study raters.

After IRB approval, the primary researcher collaborated with Amber Peplinski, MSOT student, to determine best practices for filming video models for children with ASD. Filming for the intervention videos began initially using a tablet as a video camera but due to poor sound quality, color, and cinematography, a professional videographer was hired to film and edit the eight video models.

From February to March 2016, videos were filmed in the Betty Brinn Children' Museum and edited by Scott Baldwin, professional videographer. Baldwin provided time, equipment and expertise to the study and was given a stipend as compensation.

Child actors were used for these videos, two girls ages 6 and 8, and two boys ages 6 and 8. The scripts and camera shots were written ahead of time by the primary researcher but variations were made during filming to accommodate the children's acting capabilities.

The hypothesis from the proposal was revised after an additional literature review to better record interaction and play behaviors of the participants. The proposal hypothesized that the ScanDo! app would increase (1) the amount of time that the child remained at the exhibit, (2) the amount of appropriate and relevant gestures made by the child, and (3) the amount of appropriate and relevant language used by the child. The use of an on-task definition was used for this study's hypothesis to include relevant and appropriate gestures(2) and language(3). By combining the two hypotheses from the proposal into one definition and including play behaviors from other assessments, the hypothesis became easier for the raters to use for collecting data. The revised hypothesis predicted that the ScanDo! app would (1) increase the amount of time the participants played in the exhibit, (2) the amount of time they played at each station, and (3) the frequency of play behaviors.

The decision to use raters instead of video recordings of the participants was considered at this time. It was decided that to accommodate schedules of the museum and the participants, it would be best to hold trials during public hours at the museum. As a consequence, participants could not be video-taped due to the risk of recording other patrons in the museum without their consent. An amendment was submitted to IRB in July, 2016 to use observers for data collection instead of video recordings of participants.

Two research assistants were selected and trained for data collection in June and July, 2016. Trials were held July through August, 2016. A second IRB amendment was submitted in September, 2016 to obtain additional information from participants after completion of the study in order to follow UWM policy for the disbursement of grant funds. Data were transcribed and analyzed in August through October of 2016.

Summary of Changes

The method of creating the intervention videos began as amateur video attempts. Based on the literature and Amber Peplinski's master's project, it was determined that professional videos would be more appropriate for this study. The reasoning was that children are most familiar with professional videography because they see it on television and in movies. Professional videography provides deliberate shot composition, clear transitions between shots, and quality photography and sound. This allows the viewer to focus only on the filmmaker's targeted content. At this time, Baldwin was hired to film and edit the intervention videos.

The study design was adjusted based on feedback provided by the committee of advisors and the Evidence-based Technology Intervention academic group. The definition of on-task behavior used in this study was developed to be most applicable to the museum setting and population. The use of technology was added to the quantitative data collection form to get an objective recording of when the participants were looking at or operating the tablet. This was determined by the committee and academic group as appropriate due to the difficulty of using the on-task definition to rate this activity. The subjective rating of using a tablet in a children's museum could not quickly or accurately be rated as on-task or off-task as this is not a typical way to

interact within a children's museum. Furthermore, the addition of the technology category would provide a measure of how frequently the children were using the tablet during their trial.

Changes made after data collection included a decrease in the number of participants from five to two and the use of an A-B-A instead of A-B-A-B design to accommodate participant, museum, and research staff schedules. All other protocol and procedures remained intact.

Part II: Research Manuscript

Abstract

The purpose of this exploratory study was to determine if the ScanDo! app intervention is an assistive technology that increases interaction for children with Autism Spectrum Disorder (ASD) in a museum setting. The ScanDo! app intervention presented a video demonstration that modeled the interaction for each learning station by scanning the QR code attached to the station. Using a naturally occurring baseline single-subject design with ABA and reversed ABA phases, two children with ASD and their parents visited the grocery store exhibit at a children's museum. Observers of the trials and questionnaires completed by parents before and after each trial documented play behaviors and location. We hypothesized that the intervention would increase quality interactions and length of play. Dependent variables were the location of the child and the quality of play for each ten seconds during the trial. The results showed that during the ScanDo! app intervention, both participants had a more even distribution of time spent at each station, increased transitions between stations, and decreased amount of time at stations where participants demonstrated unproductive play. These findings suggest that the ScanDo! App intervention helps increase transitions for children with ASD to provide more learning environments and productive play opportunities.

Introduction:

The following background describes Autism Spectrum Disorder (ASD) in children and strategies that are being used to assist this population. It describes the need for accessibility in community settings for families of children with ASD. It gives evidence of community settings using technology to increase access for people with disabilities. Finally, this background explains how using one particular app accessed on a tablet could make children's museums more accessible for those with ASD.

Background:

Autism Spectrum Disorder Diagnosis

ASD is a developmental disorder that causes impairment in reciprocal social communication and interaction, as well as restricted, repetitive patterns of behavior, interests, or activities (American Psychiatric Association, 2013). Children with ASD often experience nonproductive play due to delayed or lack of speech, deficits in social interaction and initiation, and fixated interests in repetitive speech and stereotyped motor movements (American Psychiatric Association, 2013).

Children with ASD suffer from these impairments as compared to typically developing children who learn many skills from play including language development, nonverbal communication, cognitive development and role-taking (Smith & Pellegrini, 2008). These skills are not only important for being successful in school, but also for interacting within the community. ASD creates difficulties for families when going into the community as the child may become distracted or upset, causing a disruption to the activity. Since children with ASD struggle to develop these skills it is important to

promote productive play in order for them to gain from all academic and social environments.

Children with ASD also struggle with transitions from one activity to the next due to their inability to predict or understand changes causing them to become upset and defiant (Cihak, 2011; Pierce et al., 2013). Interventions to improve these transitions include visual schedules and video modeling to allow the child to predict the next activity and the expectations associated with it (Cihak, 2011).

Video Modeling

Video Modeling (VM) is the demonstration of a desired skill using a video recording with the intention of having the viewer imitate the observed behavior. The basis for VM comes from Albert Bandura's Social Learning Theory which says that children learn through observation of skills performed by others rather than through personal experience alone (Bellini & Akullian, 2007).

VM promotes positive play skills such as imitation and initiation in children with ASD (Cardon & Wilcox, 2011; Nikopoulos & Keenan, 2003) as well as complex play sequences and pretend play (D'Ateno, 2003; Macdonald, 2005). VM is also effective for promoting social-communication skills, functional skills, and behavioral functioning in children and adolescents with ASD. In addition, it bolsters skill acquisition which is necessary for productive and meaningful social interactions. The skills acquired from VM are maintained over time and transferred across persons and settings (Bellini & Akullian, 2007) which makes it an effective intervention strategy for children with ASD.

Tablet Use for Children with ASD

There is a growing trend to use tablet computers and smartphones in a variety of environments for children with ASD because they are affordable, portable, widely available, and have a variety of functions (Shah, 2011; Yee, 2012). Some of these functions are gaming, reading, word processing, emailing, accessing social media and watching videos. The use of tablets by children ages 0 to 8 has increased sharply from 8% in 2011 to 40% in 2013 (Holloway, 2013) making them a tool many are already familiar with. Many of these devices have a touch screen interface which is especially appealing and easy to use for those who have weak fine motor skills (Yee, 2012) such as children with ASD.

Accessibility in the Community for Promoting Participation for Children with ASD

Children with ASD may have challenges when participating within their communities due to their social, communicative and cognitive delays as well as their engagement in inappropriate toy play or social behavior. Although caretakers may prepare children at home or in school for community activities, there are many novel activities that the caretaker cannot foresee or provide adequate training for in advance. In addition, a child may need assistance or instructions every time they do a task regardless of whether they have completed the task before. A tablet is a portable and affordable Assistive Technology (AT) for children with ASD to access VM in the community by promoting interaction between the child and his/her environment. Museum visitors with learning disabilities appreciate being able to watch videos or listen to audio repeatedly (Haworth & Williams, 2012). There has been an increased interest in making museums accessible for all patrons including those with cognitive or

developmental disabilities, such as ASD, who may need assistance processing, understanding or interacting with the exhibits (Haworth & Williams, 2012).

Quick Response (QR) codes are two-dimensional barcodes that link to information about the object to which they are attached when scanned. QR codes can be used by museums to help visitors by guiding them through the exhibit (Haworth & Williams, 2012), accessing information through text, pictures and videos (Koutsoudis, 2012) and personalizing their visit (Schultz, 2013) to increase engagement. Since patrons usually already have their own device to scan QR codes, they are inexpensive for the museum to implement (Haworth & Williams, 2012). However, there is limited research on using QR codes attached to video models as an accessibility tool for patrons with ASD.

ScanDo! App

The ScanDo! app allows the user to scan product barcodes and QR codes to instantly view a video model that shows the user how to use the item scanned (Cognitopia Software, 2013). This app is intended for use by people with a cognitive disability, such as ASD (Cognitopia Software, 2013), and would allow the users to have quick, easy and repeatable access to an audio-visual that could guide them through any task that they may encounter (Davis, 2015). Figure 1 shows a ScanDo! user accessing a video by scanning a QR code.

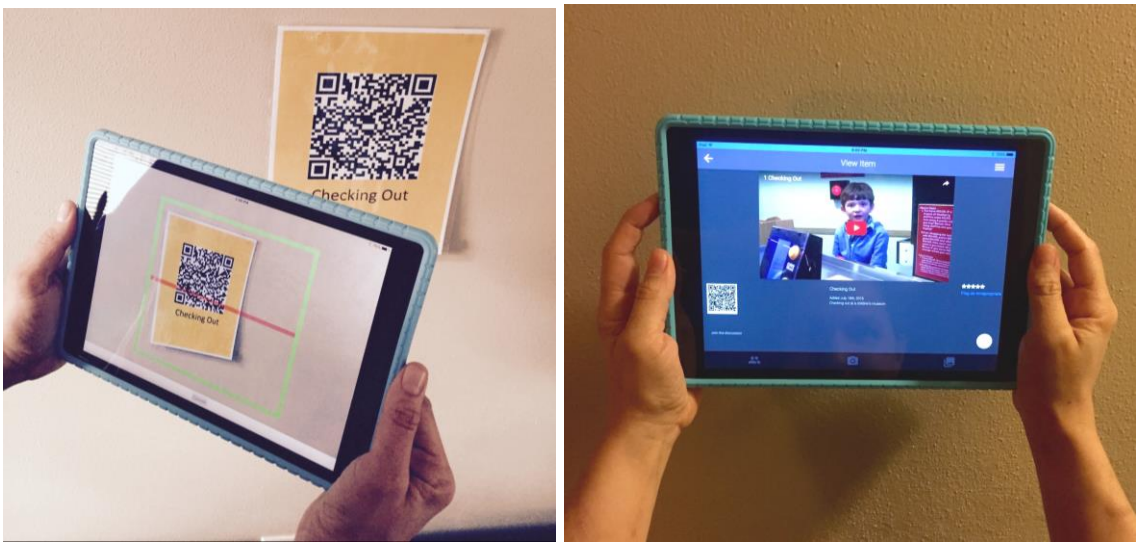

Figure 1. The photo on the left is of a user holding a tablet and scanning a QR code with the ScanDo! app. The photo on the right is of a user holding the tablet after the QR code has been scanned displaying a YouTube video.

This study aimed to determine if VM accessed through the ScanDo! app is effective in increasing appropriate interaction for children with ASD in a museum setting. The hypothesis was that the ScanDo! app would (1) increase the amount of time the participants played in the exhibit, (2) the amount of time they played at each station, and (3) the frequency of play behaviors. It also aimed to find an AT that can be affordably and widely implemented in community settings.

Methods:

Study Design

An exploratory study was performed to determine the effectiveness of the ScanDo! app on increasing the interactions between children with ASD and the exhibit at a children's museum. Many assessments have been used for this population to quantify the severity of ASD (Carr et al., 2014; Cooper, p.23, 1995; Mays, 2009). However, since each child with ASD has a unique combination of impairments making it difficult to compare individual children, a multiple-baseline Single Subject Design (SSD)

with A-B-A-B phases was selected to measure the effectiveness of the ScanDo! app. To accommodate schedules of participants and the hosting museum, an A-B-A design was used. The parents, participants, and raters were blinded to the intervention and purpose of this study. This was accomplished by describing the study to raters and parents as “a way to test out a few different apps” instead of one particular app.

IRB approval was obtained before recruitment began and parental consent obtained prior to participation (See Appendix E for consent forms). Recruitment took place through emails and posters at a college campus, a children’s museum and an autism advocacy organization (See Appendix C for recruitment flyer).

Environment

The study took place in an urban midwestern children’s museum. This museum aimed to provide hands-on educational experiences that help children learn important concepts and skills, and to educate adults about this learning process (Betty Brinn Children’s Museum, 2015). The museum included an interactive health science exhibit focusing on exercise, nutrition and personal care. There was also an exhibit for role playing members of the community with a post-office, bus, mechanics shop, and grocery store. The grocery store exhibit, which included a checkout counter and shopping aisles, was the setting for this study.

Variables and Instruments

Dependent variables measured included the total length of time the child stayed in the exhibit, the amount of time he/she interacted at each station and the quality of play. Instruments were developed to measure and analyze the dependent variables for each hypothesis during the trials (Table 1). To measure quality of play, a literature review was completed focusing on assessments that measure observable play behaviors including participation, social interaction, imitation, language, and attention through gross and fine motor movements (Barnett, 1991; Harrison & Kielhofner, 1986; Muys, Roger & Bundy, 2006) These assessments were reviewed for relevancy to this setting and study, then used to create a thorough and objective definition of on-task behavior. For this study, on-task behavior was defined as looking at the station or toy, producing words, sounds or gestures related to the exhibit, or transitioning or moving with intention towards a station or sound. Off-task was defined as when the participant was not doing any of these on-task behaviors. The technology category was defined as when the child was looking at, holding, or operating the tablet.

Hypothesis	Independent Variable	Dependent Variable	Instrument for Measurement
(1) The ScanDo! app will increase the amount of time the participants play in the exhibit.	Access to ScanDo! app, QR codes and VM	• Location of participant • Amount of time spent in exhibit	Quantitative Data Collection Form
(2) The ScanDo! app will increase the amount of time the participants play at each station.		• Location of participant • Amount of time spent at each station	Quantitative Data Collection Form
(3) The ScanDo! app will increase the participant's quality of play by increasing the frequency of play behaviors.		• Frequency of on-task behavior, off-task behavior, and use of technology	• Quantitative Data Collection Form • Qualitative Data Collection Form • Parent Pre survey • Parent Post Survey

Table 1. Table with hypotheses, independent variables, dependent variables, and instruments used to measure these variables.

A quantitative data collection form was developed with the input of the raters to record data at the end of every ten second interval (See Appendix H for full quantitative data form). Raters used this form to collect data every ten seconds using a vibrating timer in their pocket or a tone heard through an earbud. Figure 2 shows a completed quantitative data collection form with (1) the station the child was at circled and (2) whether they were on-task, off-task or using a tablet every ten seconds by marking that box. If the participant moved to a new station, the rater would start a new table making this form versatile, easy to use and easy to analyze. This method allowed a great number of data points and an accurate measurement of where the participant was while simultaneously quantifying the quality of play.

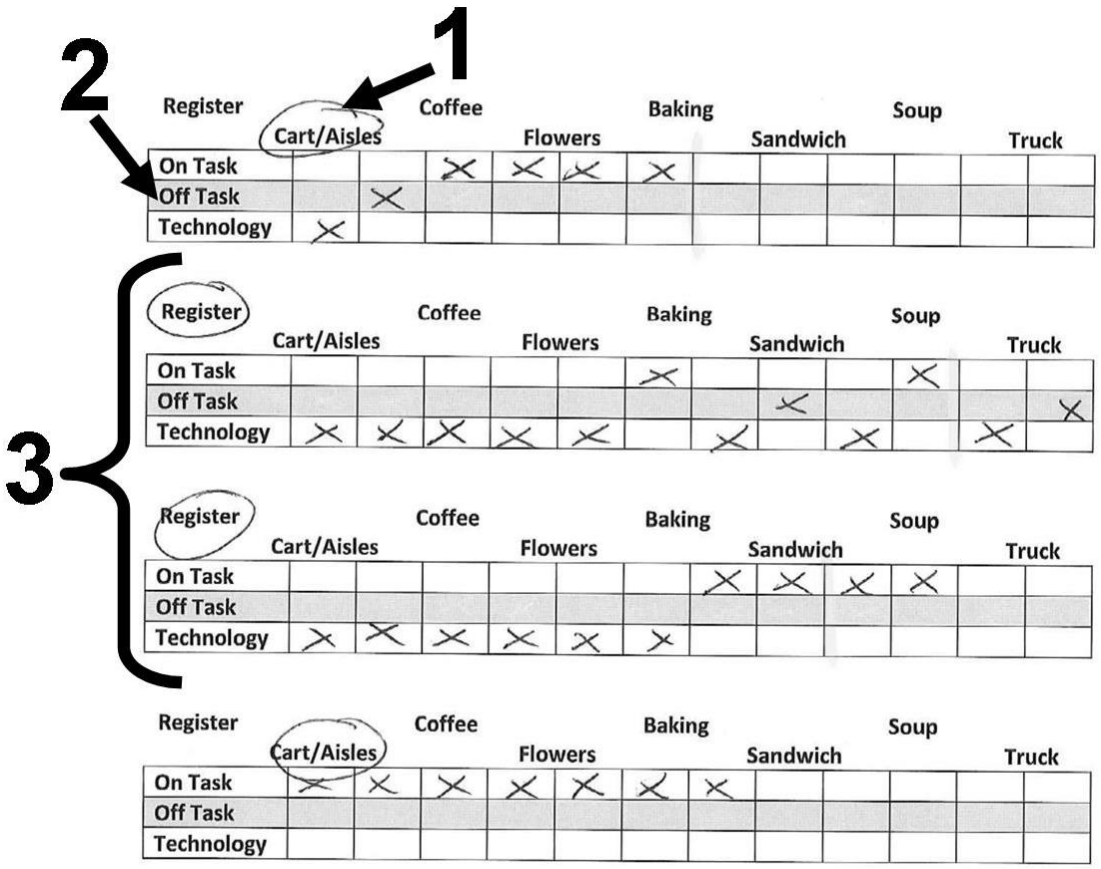

Figure 2. An excerpt from a completed quantitative data collection form shows (1) the station the participant is at and (2) whether they were on, off-task or using technology. This figure specifically (3) shows that the participant was at the register station for 3 minutes and 40 seconds and on-task for 60 second of that time.

Qualitative data was collected to provide descriptions of the play behaviors and identify anomalies, such as distractions or interruptions, which could affect the data. Qualitative data was collected through written surveys completed by each parent before and after each visit asking them to rate their child's behavior and mood, and the ease of use of the ScanDo! app (See Appendix G for full survey). Both raters and the primary investigator completed a qualitative data collection form to record observed play behaviors, interactions, and demeanors of the participant and parent for each trial (See Appendix I).

Participants

Inclusion criteria for participants were (1) age 3 to 12 (2) a medical or educational diagnosis of ASD (3) experience using a tablet or smartphone and (4) English as their primary language due to the video models being in English. Exclusion criteria was a participant's inability to attend during study hours and dates. Interested participants were given the phone number and email address of the researcher to contact if interested. Appendix D shows the screening tool used during these phone conversations. Three participants were successfully recruited but one withdrew due to scheduling conflicts.

Participant 1 was a girl age 11 with ASD whose father reported she had three iPads that she used for communication as well as for entertainment. He rated her as being very comfortable with using an iPad and that she used one for over an hour each day.

Participant 2 was a boy age 5.5 with a medical diagnosis of ASD. His mother reported he used several iOS devices including an iPad and iPhone. He used the iPad for over five hours a day and was very comfortable with it. His mother also reported that he had used video modeling a few times before with therapists and at school.

Trials

Both intervention and control phases consisted of a 10-minute scripted introduction and pre-survey for the participant and his/her parent, a 30-minute trial in the children's museum grocery store exhibit separated by at least 48 hours, and a 10-minute post-survey for the participant's parent. The introduction scripts were identical except for a brief explanation of the individual app (See Appendix F for scripts). For the

control and the intervention phase, the tablet was set to Guided Access which restricts the user from accessing any app but the one selected. Since the parents, participants, and raters were blinded, the order of the phases was different for each participant and the raters were not present for the participant presurvey, introduction, or post survey.

Control Condition

During the introduction of the control phase, participants were shown how to use the iOS Camera app to take photographs or videos of the exhibit and the people in it, and then how to view these photos and videos as they see fit. The iOS Camera app was selected as the control condition because it is standard on all iOS devices so most people are familiar with it. The use of an app during the control phase also ensured the raters and participants remain blinded to which app was the intervention since the absence of a tablet would be obvious to the rater.

Intervention

During the introduction of the intervention phase, participants were shown how to use the ScanDo! app by showing an example of a QR code and how it could be scanned to display a video model of a child using that station. Figure 3 shows the location of each station in the exhibit. These were selected to be comprehensive and evenly distributed throughout the space. The exhibit used had 8 distinct stations representing areas in a grocery store exhibit with 1 being closest to the entrance/exit and 8 being farthest.

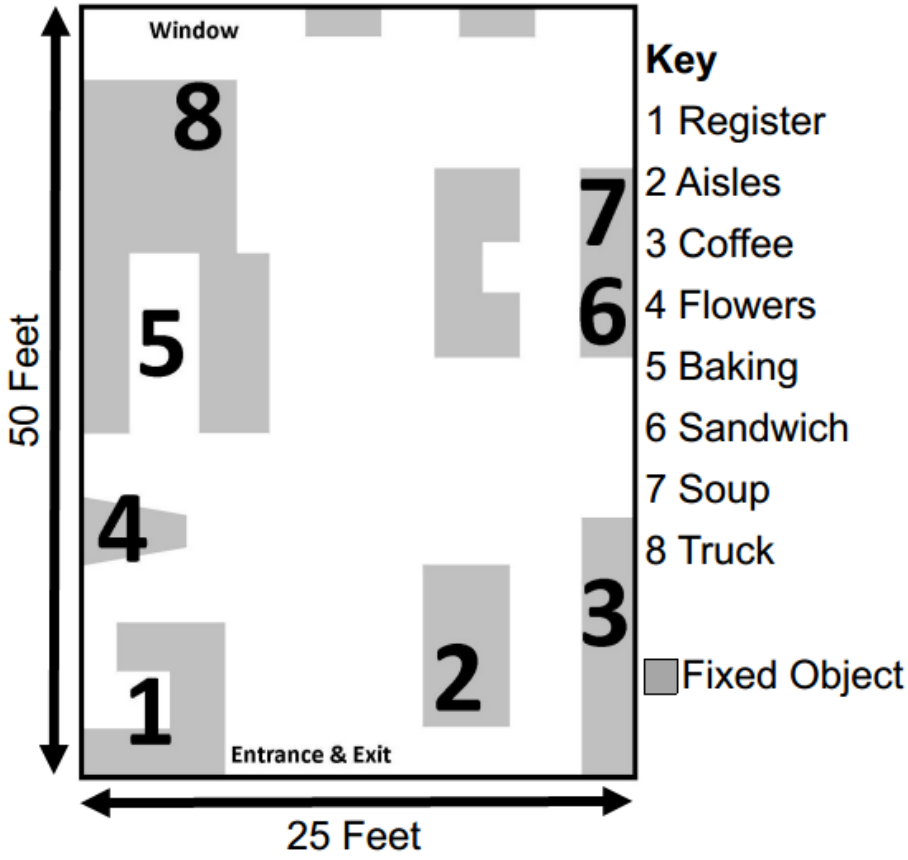

Figure 3. Map of grocery store exhibit with stations labeled by number.

These videos for each of the eight stations were developed based on a literature review to identify the ideal video content, length and video model style for this study. Peplinski's 2016 master's project was created in collaboration with this study and was also utilized for its description of optimal cinematic concepts for video models for children with ASD. Four revisions were made to the eight videos after consulting a student assistive technology group and the study committee to improve sound quality and cinematic continuity. For the final videos, a professional videographer was used for filming and editing to address these issues. The children in the videos were boys and girls ages 6 to 8 playing in the exhibit. The videos were between 24 and 52 seconds long and were recorded and edited by a professional videographer. Figure 5 shows a

description of one of the eight video models (See Appendix B for all eight video descriptions).

Station 1: Cash Register

A boy playing customer carries a basket of groceries to the register counter and takes them out one by one. As the customer unloads the groceries, the child playing cashier rings them up. After all of the groceries have been rang up, the cashier tells the customer the total and the customer gives him money. The transaction ends with the customer saying "thank you".

Figure 4. Example of one of the eight video models with a still frame and a description.

Procedures:

Data Collection

Data were collected during each visit to the grocery exhibit using the four instruments described earlier. The two trained raters were students in nursing and speech language pathology who both had experience working with children with ASD. The raters completed 10 hours of training using Youtube video clips, video clips of children playing in the grocery store exhibit, and observing typically-developing children within the exhibit to establish inter-rater reliability. During these training sessions, the raters provided feedback for both the qualitative and quantitative data collection forms which was used to improve the ease of use of the quantitative data collection form and specificity of the qualitative data.

After training, reliability was calculated using SPSS to determine Model 3 (mixed model) Intraclass Correlation Coefficient of .915 as seen in Table 1. Model 3 ICC was used because each subject was assessed by the same set of raters and findings were not generalized beyond the raters involved (Portney and Watkins, 2009).

Intraclass Correlation Coefficient						
	Intraclass Correlation Coefficient	95% Confidence Interval		F Test with True Value 0		
		Lower Bound	Upper Bound	Value	df1	df2
Single Measures	.843	.699	.922	11.759	29	29
Average Measures	.915	.823	.959	11.759	29	29

Table 2. Reliability Statistics for Interrater Reliability for using SPSS to determine Intraclass Correlation Coefficient of .915 for data from two raters during training trials.

Data Analysis

Quantitative data were analyzed by the primary investigator using visual analysis to identify changes within phases and between phases. Specifically, how long participants were at each station, how many stations they visited during each trial, and the quality of their play based on their on-task behavior.

Data were plotted for each participant's visit chronologically to show the path of their visit during each trial. Averages were calculated for the total amount of time at each station as well as the total amount of on-task, off-task and technology use behavior.

Qualitative data was analyzed subjectively to describe observed repetitive and restrictive behavior, locations where these behaviors occurred, overall demeanor of the participant and child during the trial, and distractions or interruptions that would affect data. It corroborated with the quantitative data to identify the location of the fixated interests of each participant and described these behaviors more fully.

Results:

Participant 1 was accompanied by her father for just the initial trial, but her mother and brother age 5 was there for all of the 3 trials. Participant 2 was

accompanied by his mother only for all 3 trials. Both participants' parents reported their child had never visited the children's museum before. Qualitative data showed all parents were actively participating with their child for the entirety of their visit by demonstrating play behaviors at their child's ability level, using appropriate play language and encouraging their child to participate throughout. Presurveys and post surveys from the parents revealed that the parents were cooperative and excited to play with their child during this study.

Qualitative Data revealed that both participants were nonverbal and exhibited restricted and repetitive behaviors typical of children with ASD. Participant 1 focused on looking at both hands as they manipulated a small flat toy slice of cheese at station 5, the bakery, which included an enclosed space. She also demonstrated jumping and hand-flapping. Participant 2 focused on looking out the window while intermittently jumping at station 8, the truck. While fixated on their individual station, both children did not appear to interact with any other person or toys.

Quantitative data revealed that participant 1 stayed in the exhibit for the full 30 minutes during each trial. Participant 2 stayed in the exhibit for 15, 17 and 20 minutes for each of the three trials showing an increasing trend of time length. All three trials were ended early due to participant 2 becoming upset and his mother requesting to terminate the trial, which she had been assured she could and should do at any time so that the child would remain motivated to return and enjoy his visit.

Figure 5 shows the total time the children were at each station. A visible jump is seen during the control phases of both participants 1 and 2. Participant 1 increased from 3 minutes at station 5 in the intervention phase to 10.4 minutes in the control

phase, then back to 6.8 minutes in the second intervention phase. The total length of time participant 2 was at station 8 decreased from 7.5 minutes at the control phase to 5.1 at station 8 during the intervention phase, then increased up to 9.4 for the control phase. Qualitative data revealed these were the stations where both children demonstrated restricted and repetitive behaviors. Figure 6 shows the same information to reveal the proportions at each station. The station where each participant fixated in unproductive, restricted play is apparent as it dominates the pie chart during the control phase.

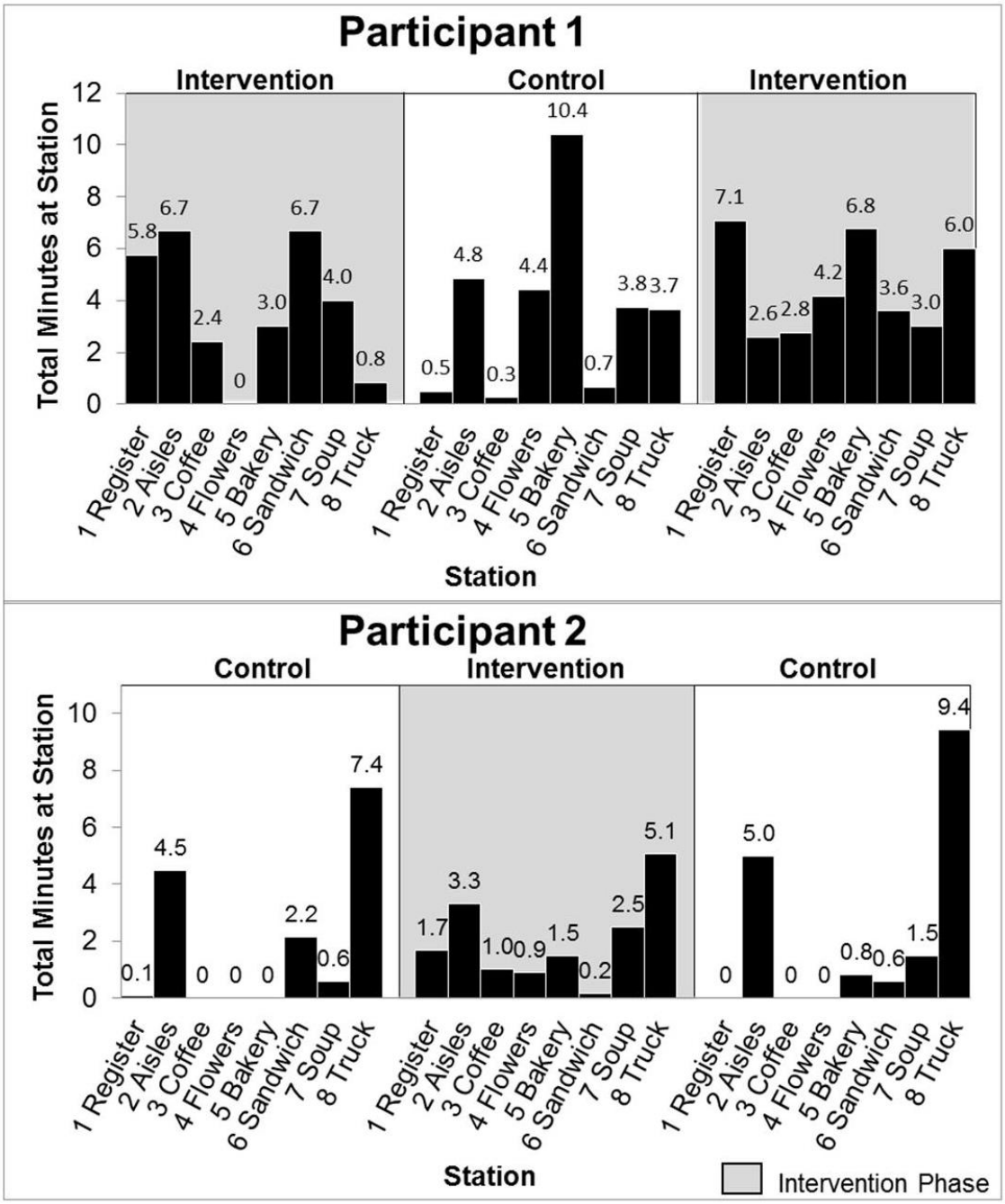

Figure 5. Graph of the amount of time each participant spent at each station during each phase of the study.

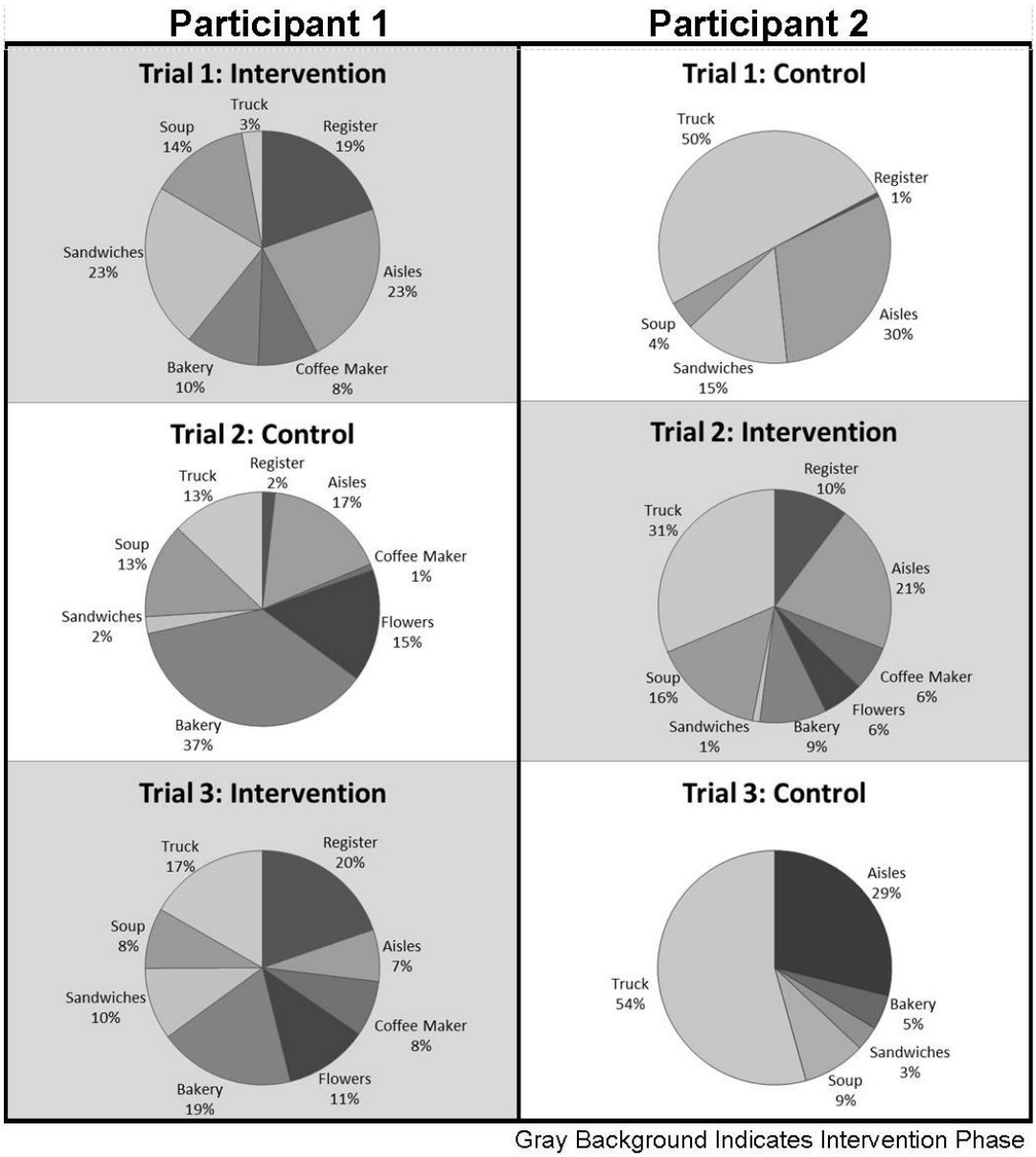

Figure 6: Pie charts showing the fraction of the total amount of the trial spent at each station.

Figure 7 shows the chronological location of each participant, including the division of time spent at individual stations during the visit. Both visited significantly more of the eight stations during the intervention phase than during the control phase. For participant 2, during both control phases he did not visit all eight stations while during the intervention phase he was able to visit every station. Since station 1 is furthest from figure 8, as seen in figure 3, the distance travelled to change stations can be seen in the jumps in figure 7. These show within ten seconds, whether the participant ran across the room or transitioned to a nearby station.

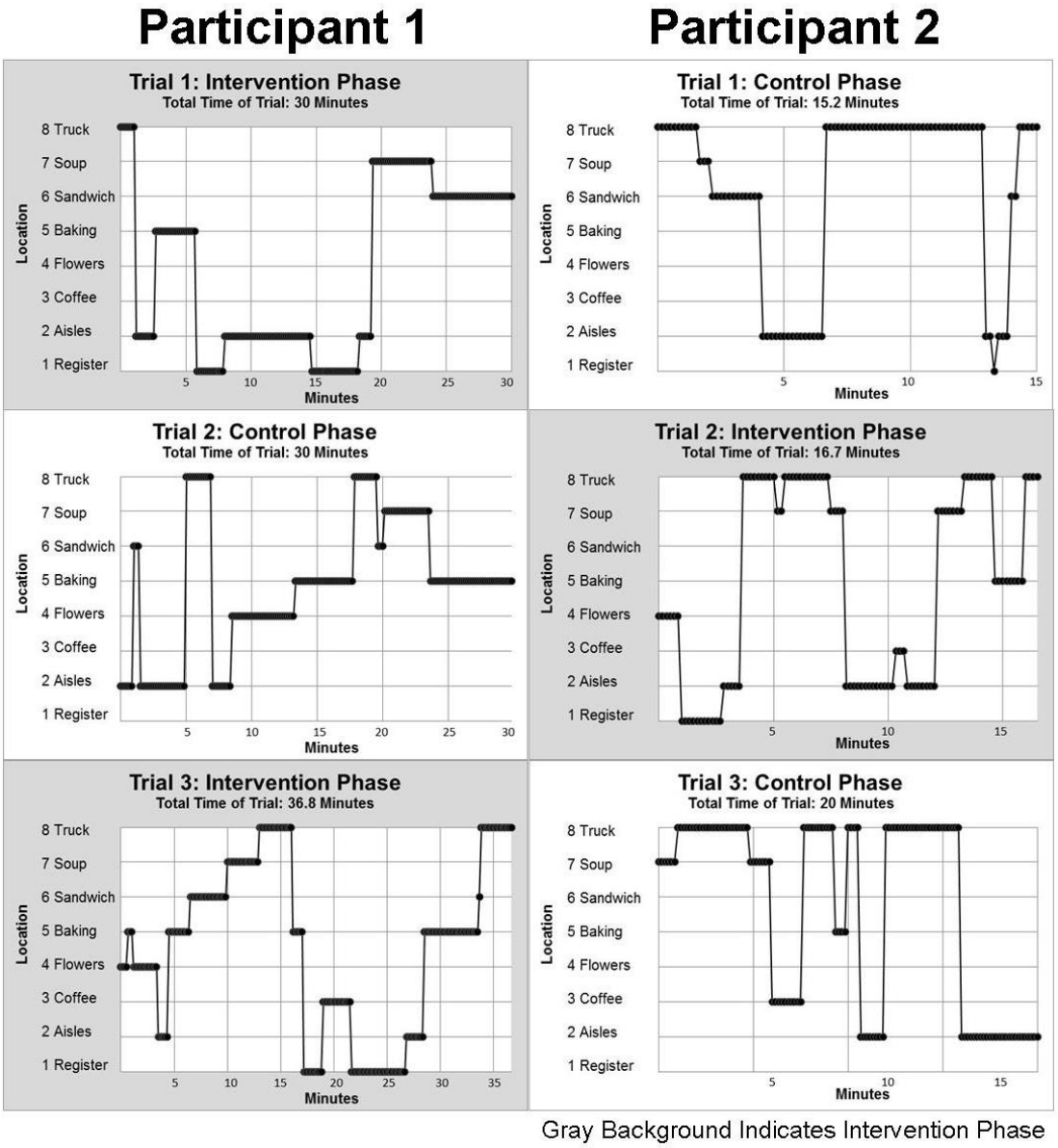

Figure 7: Line graph of the chronological location of each participant during each trial at each ten second interval. Stations are representative of relation to entrance with station one closest to the entrance and station eight furthest.

Appendix J shows graphs that compare the proportions of the on-task, off -task and technology use behaviors during each trial. There was not a significant trend for the amount of on-task behavior when compared to off-task behavior and to tablet use for either participant.

Discussion:

The hypothesis of this study was that the ScanDo! app would increase the amount of time the participants play in the exhibit, the amount of time they play at each station, and the frequency of play behaviors.

The results suggest that children with access to the ScanDo! app to view video models were better able to transition away from stations and evenly distribute their time throughout the exhibit instead of becoming fixated on one area with repetitive and restrictive play, such as flapping hands and jumping. The intervention also appeared to decrease the amount of time both participants spent at their individual fixation station. Since children with ASD have difficulty transitioning between locations and activities, this could also be an effective AT for promoting transitions and accessing the museum. Especially in a children's museum where there are many learning opportunities, it would be a disadvantage for a child with ASD to be unable to experience each one.

The ScanDo! app may be a good tool for parents to use to engage their child and show them how to interact with each station, or the VM could assist in transitioning the child away from their preferred station where unproductive play is occurring and into the other stations where productive play may occur. Whichever reason it is, the ScanDo! app appears to have helped both children to have a more balanced and comprehensive visit to the exhibit at the children's museum.

The results also suggest that the amount of time spent on-task at each station as well as the entire exhibit was not affected by the ScanDo! app. This suggests that the quality of the child's time at the museum can be increased by the app but perhaps not the quantity. Children with ASD may not be able to endure as long as their peers at museums or other community outings and this should be accommodated.

Other findings from this study were the input from the participant's parents. Both reported feeling uncomfortable bringing their child to a children's museum due to their child's disruptive behavior and the perceived feelings of the staff and parents at the museum. They were also not aware that their child would do as well as they did playing in an environment shared with other children.

The museum administration was also unaware of the potential for this intervention. The museum expressed concerns at the start of this study that the use of technology may discourage children and parents from interacting with the exhibits and other children, and could instead result in the increased use of tablets or smart phones during their visit.

Possible benefits of these findings include using VM apps like ScanDo! to make museums and community attractions accessible to children with ASD. Since videos for a public location can be watched repeatedly, a professional videographer would be advised. Children are used to high quality videos from television and movies so they are better engaged by videos with proper timing, lighting, camera angles and sound quality. However, children still could benefit from videos produced quickly and on-site to provide a demonstration of the activity because all video models can assist children with ASD.

If this study were to be repeated, it would be beneficial to increase the number of participants and complete a full ABAB study. It would also be helpful to have a true baseline with no technology being used to compare to the control app and intervention app.

Two limitations to the study are worth noting. One is that there were only two participants so results are not generalizable to the larger population of children with ASD. Another limitation is the validity of the quantitative data collection instrument in measuring productive play. The validity was only assessed by literature content and pilot testing.

Future studies on VM apps in community settings should study its effects on other populations such as children with ADHD or developmental, learning or cognitive disabilities as well as adults with ASD. It could also explore other settings that would benefit from using AT to access video models.

Future studies could also explore the attitudes of families with children with disabilities in regards to how they feel bringing their children into the community and how their inclusion, accessibility and comfort could be increased.

Overall, many children with ASD struggle to participate in the community due to their limited or selective attention, impaired social interactions, or delayed language. This study suggests the use of stations with QR codes to guide children with ASD through a children's museum increases the amount of stations they visit and more evenly distributes the time they spend at each area in the museum.

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Part III: Appendices

Appendix A: Proposal

Introduction & Literature Review

Autism Spectrum Disorder Diagnosis

Autism Spectrum Disorder (ASD) is a developmental disorder that affects a great number of school-aged children in the U.S. ASD is prevalent in 1% of the population in the world with symptoms being recognized between 12 and 24 months of age (American Psychiatric Association, p.55, 2013). The DSM-5 defines ASD as a persistent impairment in reciprocal social communication and social interaction, as well as restricted, repetitive patterns of behavior, interests, or activities (American Psychiatric Association, p.53, 2013). Examples of this behavior are lining up blocks in a straight line or spinning the wheel of a car resulting in nonproductive play that doesn't result in learning. Deficits in social interaction include sharing in imaginative play with peers or making friends. Fixated interests in repetitive speech and stereotyped motor movements are often abnormal in intensity for children with ASD (American Psychiatric Association, p.50, 2013). Many individuals with ASD have language deficits including complete lack of speech, language delays, poor speech comprehension, echoed speech or overly literal language. Young children with this disorder may show little or no initiation of social interaction and no sharing of emotions, reduced or absent imitation of others' behavior (American Psychiatric Association, p.53, 2013).

Typically developing children learn many skills from play. Starting at birth, this is one of the most important occupations of a child to experience typical healthy development. The skills acquired from regular play include motor planning, language

development, conversation skills, nonverbal communication, cognitive development and role-taking (Smith & Pellegrini, 2008). Play also promotes independence and creative thought (Smith & Pellegrini, 2008) all of which are important for children to be successful in school. Classrooms require students to interact with peers, work together in groups, solve social and academic problems and manipulate a variety of objects and tools in a productive way. Children with ASD struggle to develop these skills so it is important to promote productive play in order for them to gain from an academic and social environment.

ASD also creates difficulties for families when going into the community. The child may become distracted or upset causing a disruption to the activity. This behavior can require the parent to give one-on-one attention to their child with ASD while neglecting to have meaningful interactions with their other children.

Autism Treatments and Interventions

There are many different types of interventions for children with ASD. The most common ones are applied behavior analysis (ABA), positive behavior support (PBS), social skills training, drug treatment, sensory integration therapy, and the picture exchange communication system (PECS) (Hess et al., 2008). The ones discussed here are applied behavior analysis (ABA) and positive behavior support (PBS) because these are the most relevant to this study. In addition, naturalistic approaches will be addressed.

ABA therapy applies interventions with the goal of improving social behaviors. This is done by observing and analyzing the antecedents and consequences of the undesired behaviors (Baer et al., 1968). There are a number of related approaches that

use the principles of ABA. Discrete Trial Training (DTT) is an applied behavior analytic procedure that uses a cue, then a prompt, followed by a response and a consequence as a method of instruction (Smith, 2001). Functional Behavior Assessment (FBA) also uses ABA principles because it determines the causes of challenging behavior and ways to intervene. Then the FBA informs the PBS which focuses on the strategies that can address these challenging behaviors (Fisher, 2011).

Reciprocal Imitation Training (RIT) is a naturalistic behavioral intervention that teaches imitation to children with ASD within a social–communicative context (Ingersoll & Lalonde, 2010). RIT is a valuable and widely utilized method for teaching social skills to children with ASD. Ingersoll & Schreibman found that RIT is also effective for teaching generalized object imitation skills to young children with autism. In addition, it was found to increase language, pretend play and joint attention (2006). The results of Ingersoll & Lalonde show that adding gestural imitation training to object imitation training can increase the use of language more than object imitation alone (2010).

Since there are many different language levels for children with ASD, it is important to consider if certain interventions are more appropriate than others. Paul found that children with better receptive language did better with a naturalistic method and those with lower receptive language responded better to discrete trial treatment (2013). This suggests that RIT is more beneficial to children with ASD who have some receptive language as opposed to those who have limited communication skills.

Incidental teaching, like RIT, is a naturalistic approach to treating ASD. It uses naturally occurring interactions to teach language through labeling and describing the

objects and the environment (Hart & Risley, 1975). It is effective at producing spontaneous speech and generalization to other settings.

Video Modeling

Albert Bandura's Social Learning Theory says that children learn through observation of skills performed by others rather than through personal experience alone (Bellini & Akullian, 2007). This is the theoretical basis for Video modeling (VM). VM is the demonstration of a desired skill using a video recording with the intention of having the viewer imitate the observed behavior. VM is a general term that can describe a number of videos including point-of-view videos, videos that demonstrate conversations with peers, or videos that demonstrate a sequence.

VM has been shown to promote imitation and initiation in children with autism (Cardon & Wilcox, 2011) (Nikopoulos & Keenan, 2003). It has also been a successful strategy for teaching complex play sequences and pretend play to children with ASD (D'Ateno, 2003) (Macdonald, 2005) which, as discussed earlier, is important for learning and development. VM is also effective for promoting social-communication skills, functional skills, and behavioral functioning in children and adolescents with ASD as well as skill acquisition which is necessary for productive and meaningful social interactions. The skills acquired from VM are maintained over time and transferred across persons and settings (Bellini & Akullian, 2007) which makes it an effective intervention tool for children with ASD.

Assistive Technology Use for Children with ASD

The Assistive Technology Act of 2004 defines 'assistive technology device' as any item, piece of equipment, or product system, whether acquired commercially,

modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities (Assistive Technology Ace of 2004, P.L. 108-364). Common examples of AT include augmentative and alternative communication (AAC) as well as prosthetics and mobility devices like wheelchairs and walkers. AT is also used to provide access to standard learning tools so that children can participate equally with their peers (Judge et al., 2008). Computer-based AT can assist in communication skills, literacy skills, academic skills, social skills, emotion recognition, functional life skills (Yee, 2012), emotion recognition, and theory of mind (Ploog et al., 2013).

There is a growing trend to use tablet computers and smartphones in a variety of environments. Parents of children with ASD are using them as assistive technology (AT) to support their child even though this is not the intended purpose of these devices (Yee, 2012). This is because they are affordable, portable, widely available, and have a variety of functions. Some of these functions are gaming, reading, word processing, emailing, accessing social media and watching videos. Many of these devices have a touch screen interface which is especially appealing and easy to use for those who have weak fine motor skills (Yee, 2012).

The iPad is a tablet with a touchscreen interface that ranges in price from $250 to $600. The use of tablets by children ages 0 to 8 has increased sharply from 8% in 2011 to 40% in 2013 (Holloway, 2013). In recent years the iPad and other tablets have been widely implemented in the classrooms and homes of children as a device for learning as well as a tool for accessibility (Shah, 2011). Some accessibility solutions provided by tablets are spell check and text-to-talk. The iPad is one of the most common devices for

delivery of AT and will be used for this study to record videos and provide the participants with access to the application.

Accessibility in the Community for Promoting Participation for Children with ASD

Children with ASD have challenges when participating within their communities due to their social, communicative and cognitive inabilities. Parents described their child's successful participation as having fun, feeling successful, doing and being with others, and doing things independently (Bedell, 2011). Children with ASD have difficulty with successful participation because they often engage in inappropriate toy play or social behavior.

There are many times that children learn outside of the classroom for a field trip or a community outing with their family. Wishart & Triggs found that teachers feel students learn best from engaging with authentic artifacts such as those found in a community or museum setting because it makes the learning less abstract and more relevant (2010). Students with ASD may struggle in these settings due to their challenges with appropriate social interactions and object interaction.

Although caretakers often prepare their child at home or in school for community activities, there are many novel or unique activities that the caretaker cannot foresee or provide adequate training for in advance. In addition, a child may need assistance or instructions every time they do a task regardless of if they have completed the task before. To prepare for these activities, parents and teachers could use VM within the community to promote interaction between the child and their environment.

Accessibility at Museums Using QR codes

There has been an increased interest in making museums accessible for all patrons. Implementations to achieve this include access ramps and elevators for those with mobility challenges. Virtual museums are another solution for those who struggle with traveling to museums. These make it possible for patrons to navigate the museum remotely and explore exhibits from their computer or tablet (Koutsoudis et al., 2012). Mobile guides have also used audio-video technology to direct the patron through the exhibit to encourage interaction (Sung et al., 2010).

Accessibility also affects those with cognitive or developmental disabilities who may need assistance processing, understanding or interacting with the exhibits. Quick Response (QR) codes are a two-dimensional barcode that contains information about the object to which it is attached. Implementation of QR codes are practical in a museum setting because it is inexpensive due to the fact that patrons often already have their own smartphone or tablet (Haworth & Williams, 2012). The museum would not have to provide an additional device and patrons could access text, pictures and videos on their device within the museum. Young people and smartphone users are generally familiar with using QR codes. This means that museums would not have to train them on how to scan the codes using their device.

QR codes can be used by museums to help visitors personalize their visit (Schultz, 2013). They have been used to guide the visitor through the museum by following a trail of QR codes through the exhibits to successfully increase engagement by the visitors (Haworth & Williams, 2012). These codes have also been used to provide information about the building or historical object to which it is attached as a way to create an informative learning opportunity (Koutsoudis, 2012).

Museum visitors with learning disabilities appreciate being able to watch videos or listen to audio repeatedly (Haworth & Williams, 2012). However, there is limited research on using QR codes attached to video as an accessibility tool for patrons with ASD.

The Betty Brinn Museum is a nonprofit children's museum located in downtown Milwaukee and the location where this study will be carried out. Their mission is to provide interactive exhibits and educational resources that promote the healthy development of children in their formative years. The museum is committed to providing access to all children and families in the community including special needs families (Betty Brinn Children's Museum, 2015). The museum has demonstrated a marked interest in working with the University of Wisconsin Milwaukee to support research as well as to promote and increase accessibility in their facility.

The Sendik's exhibit at the Betty Brinn Children's Museum is a grocery store setting. The exhibit includes a checkout aisle, shelved groceries, a bakery and a flower shop. It is designed to allow children to interact with models and toys in imaginative and pretend play. This exhibit is the setting for this study.

ScanDo! App

The ScanDo! app was developed by Cognitopia which is a company that aims to find simple solutions to everyday problems for people with ASD. The ScanDo! app allows the user to scan product barcodes and QR codes to instantly view video or text instructions that show the user how to use the item scanned (Cognitopia Software, 2013). For example, a person could scan a QR code that is next to a microwave. The ScanDo! app would then link them to a YouTube video with a demonstration of how to

use the door and the buttons on the microwave. This would allow the user to have quick, easy and repeatable access to an audio-visual that could guide them through any task that they may encounter. This app is intended for use by people with a cognitive disability such as autism, intellectual disabilities, brain injury or Alzheimer's as well as for aging adults or ESL speakers (Cognitopia Software, 2013). To date, there is no research on the efficacy of the application in a museum setting and the company is interested in receiving evidence-based feedback as well as suggestions for personalization of the app for the ASD population.

Measuring ASD and Interaction

Determining the severity of ASD is a difficult task as the condition affects each child very differently. The DSM-5 diagnostic criterion is used by physicians to make a medical diagnosis. An educational diagnosis is made by a multidisciplinary evaluation team of various school professionals to determine whether a student qualifies for special education and related services under the Individuals with Disabilities Education Act (IDEA) (The Autism Society). There have been a number of attempts to quantify the severity of ASD based on IQ, The Childhood Autism Rating Scale (CARS), and the functional communication of the child (Carr et al., 2014), (Cooper, p.23, 1995). However, each child with ASD has a unique combination of impairments that makes it difficult to group them together with others on a similar level of severity using these assessments. This means that a study with a control group would be difficult to carry out and would not produce meaningful results. A Single Subject Design (SSD) would produce more meaningful data and would be more appropriate for this population. The

ABAB design establishes stability of the baseline phase, and then collects data on the intervention phase before finally returning to the baseline phase (Portney, 2000).

Measuring Interaction is another challenge when working with this population. Children with ASD may interact with the exhibits but not in an appropriate or productive way. For example children may line up cars instead of using imaginative play to push the cars down the road. For this reason, assessments have been devised for children with disabilities to measure engagement and purposeful play.

The Children's Playfulness Scale (CPS) was designed to measure physical spontaneity, social spontaneity, cognitive spontaneity, manifest joy, and sense of humor (Barnett, 1991). The CPS has high internal consistency across samples and between raters as well as good construct validity (Trevlas et al., 2003). Test of Playfulness takes 15 items from the CPS in order to create a scale that is observational and based on a different concept of playfulness than the CPS (Bundy & Clifton, 1998).

The Knox preschool play scale is another assessment. It measures space management, material management, imitation, and participation and has acceptable reliability and validity (Harrison & Kielhofner, 1986). It is intended for observation in both indoor and outdoor natural settings so it would not be appropriate for assessing a child in only a museum setting.

Purpose of the Study

Specific Aims and Objectives

This study aims to increase the accessibility of children's museums for children with ASD. Since children with ASD have difficulty learning from and interacting with toys and their peers, they would benefit from a device that assists them in doing so. The ScanDo! app can scan the QR code of each station in an exhibit in order to display a video that models the appropriate way to play with the station. This study aims to determine if this app is effective in increasing appropriate interaction for children with ASD in a museum setting. It also aims to determine ways in which the ScanDo! app can be improved to further promote accessibility.

Research Question

Does the ScanDo! application increase interaction between children with Autism and the exhibit in a museum setting?

Hypothesis

Given each child with ASD using the ScanDo! app in the exhibit, three things will occur:

1. The amount of time that the child remains at the exhibit will increase during the intervention phase.

2. The amount of appropriate and relevant gestures made by the child will increase during the intervention phase.

3. The amount of appropriate and relevant language made by the child will increase during the intervention phase.

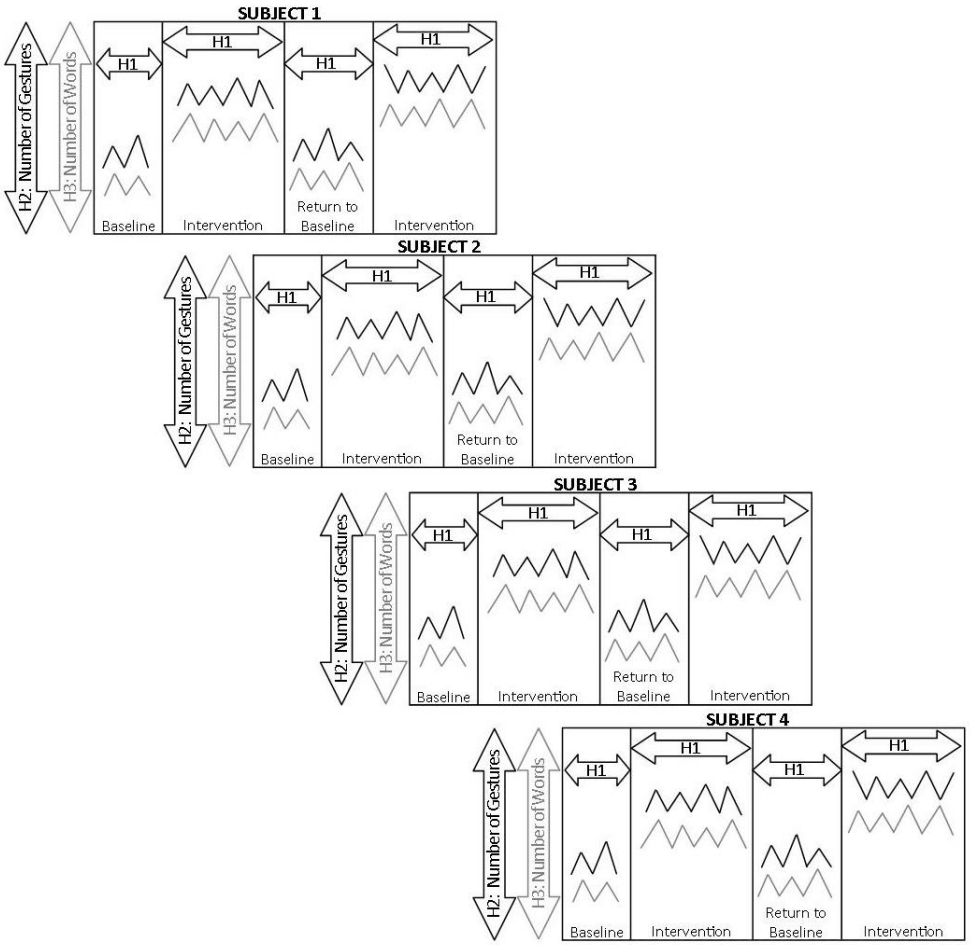


Figure 1:

Study Design

Methods

Study Design

An exploratory study will be performed to determine the effectiveness of the ScanDo! app on increasing the interactions between children and the exhibit at a children's museum. The study design will be a naturally occurring multiple baseline ABAB single subject design. The baseline phase will consist of the child playing in the exhibit without the ScanDo! app on a device. The intervention phase will consist of the same participant playing in the exhibit while having access to the ScanDo! app on a device. There will be a return to baseline after the intervention phase so there will be a total of four visits to the museum. Hypothesis one will measure the amount of time that the child stays at the exhibit. Hypotheses two and three will measure the amount of gestures and words used by the child during each phase.

Variables

Independent Variables:

Use of the ScanDo! app

Dependent Variables:

Appropriate and relevant gestures include non-repetitive or stereotypic play, gestures or movements with the objects at the station. It also includes imitating or imaginative play related to the exhibit. It also includes eye gaze at the objects at the station.

The amount of appropriate and relevant language made by the child. Appropriate and relevant language includes non-repetitive or stereotypic spoken words or spoken approximations. It also includes exclamations or sounds made in response to the exhibit

either because the child is imitating the exhibit or because the sounds are made shortly after the antecedent.

The behavior of the child reported by the parent

The ease of use of the ScanDo! app reported by the parent

Participants

The participants for this study will be 5 children between the ages of 3 and 9 with a medical or educational diagnosis of ASD. The participants will have at least some experience with a tablet or smartphone. This can be from any use or exposure at school, at home or in the community. IRB approval will be gained before recruitment begins and parental consent will be obtained prior to participation. Recruitment will take place at the University of Wisconsin Milwaukee campus as well as at the Betty Brinn Children's Museum. Posters will be placed throughout the Milwaukee area for recruitment. The researcher will also contact Betty Brinn directors and Autism Speaks to recruit participants.

Instrumentation

Each child's visit to the museum will be video recorded. These videos will be analyzed using NOLDUS Observer. The videos will then be watched and the quantity of appropriate interaction behaviors will be measured. Appropriate interaction behaviors will include relevant spoken words, relevant gestures, relevant actions, and relevant eye gaze. These videos will be divided into clips and put in random order for the coders to watch and measure.

Each parent will also be given a written survey before and after each visit to the museum. The surveys will ask the parent to rate on a 6-point scale their child's

behavior. The pre-survey will ask the parent to rate the child's mood and temperament. The post-survey will ask the parent to rate the child's experience including the child's ability to maintain focus and the child's interactions with the exhibit. The post-survey will also ask the parent to rate the ease of use of the ScanDo! app and to identify improvements that they feel would be helpful.

Procedures

This study will be conducted over 19 months as shown in the figure below. An Institutional Review Board (IRB) will approve this study before participants are recruited.

Thesis Gantt Chart																		
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
F= Primary Researcher on Fieldwork and Unavailable																		
Identify a Research Theme																		
Thorough Review of Literature	X	X					F	F	F							F	F	F
or Data Collection and Analysis	X	X					F	F	F							F	F	F
Complete IRB	X	X					F	F	F							F	F	F
Select Committee Members	X	X					F	F	F							F	F	F
Film Practice Videos		X					F	F	F							F	F	F
werpoint proposal presentation		X	X				F	F	F							F	F	F
Submit proposal draft to advisor			X				F	F	F							F	F	F
Submit proposal to committee			X				F	F	F							F	F	F
Schedule Committee Meeting				X			F	F	F							F	F	F
Committee Meeting				X			F	F	F							F	F	F
posal with Committee feedback				X			F	F	F							F	F	F
Film Videos				X	X	X	F	F	F	X						F	F	F
Conduct Research																		
Submit IRB & Obtain Approval				X	X	X	F	F	F							F	F	F
nd Protocols for Data Collection				X	X		F	F	F							F	F	F
Include Roger as a Participant							F	F	F	X						F	F	F
Recruiting							F	F	F	X	X					F	F	F
Collect Data							F	F	F		X	X				F	F	F
Analyze Data																		
Transcribe Data							F	F	F			X	X			F	F	F
Analyze Data							F	F	F			X	X			F	F	F
Write Thesis																		
mplete Last Chapters of Thesis							F	F	F			X	X	X		F	F	F
Give Complete Draft to Roger							F	F	F				X			F	F	F
Revise Thesis Draft							F	F	F				X			F	F	F
Submit Thesis to Committee							F	F	F					X		F	F	F
Create powerpoint Defense							F	F	F					X		F	F	F
Give Powerpoint Draft to Roger							F	F	F					X		F	F	F
Present Thesis Defense							F	F	F					X		F	F	F
nesis with Committee Feedback							F	F	F					X		F	F	F
Submit Thesis																		
Obtain committee Approval							F	F	F					X		F	F	F
nplete final draft of thesis/article							F	F	F					X		F	F	F
Revise article for submission							F	F	F						X	F	F	F
Submit article							F	F	F						X	F	F	F
of thesis title page and abstract							F	F	F						X	F	F	F
proved reviews with grad school							F	F	F						X	F	F	F
copy to grad school for approval							F	F	F						X	F	F	F
Deliver copies to OS&T, R2D2							F	F	F						X	F	F	F

Figure 2: Gantt Chart

Filming Videos

All visits will take place in the Sendik's exhibit of the Betty Brinn Children's Museum. This exhibit has 12 stations representing a grocery store setting. These stations include a cash register, a bakery and grocery aisles. Each station will have a

QR code attached to it that will bring up a video of a child using that station when scanned with ScanDo! app. The children in the videos will be ages 3-9. These actors will be recruited by the researcher and by word of mouth.

The videos will be approximately 15 seconds long. The cinematography methods will be developed by Amber Peplinski, an occupational therapy student at UW Milwaukee, who is completing her master's project on the topic of video modeling for children with ASD.

Recruiting

Recruitment will begin with the researcher contacting the Betty Brinn Museum and organizations specializing in Autism to promote the study and find possible participants. Inclusion criteria for this study will be a child with a medical or educational diagnosis of ASD, age 3-9 years old, some experience with tablets or smartphones, and transportation to the Betty Brinn Children's Museum where this study will be held. The primary investigator will call the interested families on the phone to gather the information needed to complete the screening survey. If this reveals that the child is eligible for this study, then the parents will fill out an informed consent form.

After the four eligible children have been given informed consent, the family will be scheduled to visit the museum. The parents of each child will be encouraged to schedule several dates and to feel comfortable cancelling their visits if they feel their child is having an abnormal day due to behavior or circumstances. Each child will visit the museum with their parents before the museum is open between 8am and 9am so that there is not interference or distraction by other families.

Trials

The setting of the study will be the Betty Brinn Children's Museum. During each of the four phases, the child will be allowed to play freely with the 12 stations of the exhibit. There will be a QR code with a video of a child playing with each station appropriately for a total of 12 videos. The QR codes for these videos will be located at each station so that the child can view them in the location where they will play. There will be at least a week between each visit but no more than 6 weeks between visits.

Data Collection

All visits will take place in the Sendik's exhibit of the Betty Brinn Children's Museum. Upon arrival to the first visit, the parent of the child will fill out a pre-survey. The first visit for each child will be a baseline phase so they will be given an iPad but not instructions or the installed ScanDo! app. After their visit, the parent will fill out a post-survey about their perception of the child's behavior and their impressions of the museum.

Upon arrival to the second visit, the parent of the child will fill out a pre-survey. The second visit for each child will be an intervention phase so they will be given an iPad and instructions on how to use the ScanDo! app. After their visit the parent will fill out a post-survey about their perception of the child's behavior, their impressions of the museum and their opinion of the ScanDo! app.

The third visit will use the same procedure as the initial visit because it is the return-to-baseline phase. The fourth visit will use the same procedure as the second visit because it is the second intervention phase. All surveys and videos will be coded to be kept confidential and stored in a secure location at the R2D2 lab at UW Milwaukee.

Observation and Instructions for RA

Research assistants will be utilized for data collection at the Betty Brinn Children's Museum. The research assistants will read a script to the participants explaining the purpose of the study and the schedule of their visit. They will complete an introduction and tour of the Sendik's exhibit at the beginning of each visit. They will also complete a demonstration of the ScanDo! app for the intervention phase. Research assistants will fill out the field notes located in Appendix F for each visit.

Data Coding

There will be two types of data. The first will be the videos collected of the participants playing in the exhibit. These will be coded by dividing the recordings from each visit into 5 minute increments. Then the data coders will watch each video and quantify the number of appropriate gestures and words.

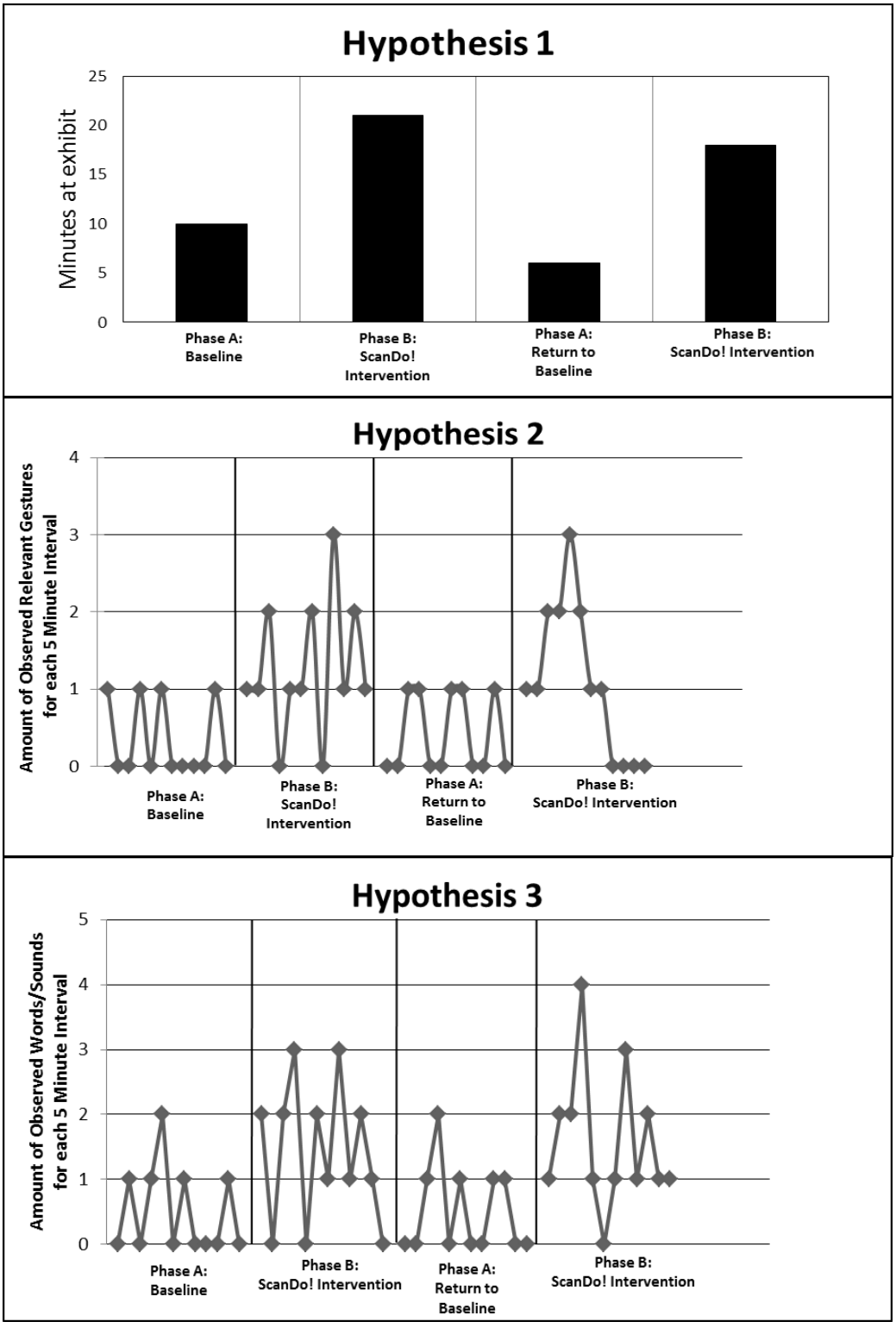
The other type of data will be the questionnaires completed by the parents. These surveys will quantify the parent's opinion of their child's behavior before their visit, their child's behavior during their visit, and the quality of their interactions in the exhibit.

Data Analysis

Qualitative and quantitative data will be collected for this study. The surveys completed by the parents will be answered on a 6-point scale. There will also be short answers for the parents to express opinions that are not covered by the scaled questions. The baseline stages will be compared against the intervention stages. This will be done by measuring the length of time the child stays at the exhibit without the ScanDo! app against the length of time stayed at the exhibit with the ScanDo! app.

Similarly, the amount of appropriate gestures will be measured against the amount of gestures with the ScanDo! app, and the amount of appropriate words will be measured against the amount of words with the ScanDo! app. Visual analysis will be used to analyze the data for each hypotheses. Hypothesis one will be analyzed using Chi-Square. Hypotheses two and three will use Simulation Modeling Analysis. The standards for Simulation Modeling Analysis are outlined by Kratochwill et al. and will be adhered to for this study (2010).

Figure 2: Possible Results



Plan for Administrative Support

Budget

The study will require funding for equipment and compensation for research assistants and participants. The ScanDo! app will be provided free by the creator of the app to further research on the product and improve upon its design. For this reason, the QR codes for the exhibit will also be free. The facilities will be provided by the Betty Brinn Children's Museum which would like to promote research within its facilities and to increase accessibility of its exhibits to children of all abilities. Each participant and their family will be given a $50 gift card to either Target or Wal-Mart as compensation for their time. They will also be given $5 for parking for each visit to the Betty Brinn Children's Museum. Two research assistants will be required to collect and analyze data so that it is unbiased. They will be compensated for their time by receiving a $100 stipend for the estimated 60 hours they will be working on this project. Finally, the iPad holders for a tripod will be needed to record video modeling videos and also the participants while in the exhibit. One has already been donated by Dr. Roger Smith of the R2D2 Lab but two more are required to carry out this study. The total for this research study is $810. Funding for this study will be received from the College of Health Sciences student research awards. A breakdown of these costs can be found in Table 1.

Table 1: Estimated budget for entire study.	
ITEM	COST
ScanDo! App	Donated by the president of the Cognitopia software company, Dr. Thomas Keating
QR Codes	
Facilities	Donated by Betty Brinn Children's Museum
Gift card for participants (5 participants x $50)	$250
Parking/Transportation Costs (5 Participants x $5 x 4 visits)	$80
Student Research Assistants (2 research assistants, $200 each)	$400
Tripod Stands for iPads (3 x $50)	$100 (One has already been donated by Dr. Roger Smith of R2D2 at UW Milwaukee)
TOTAL	**$810**

Resources and Environment

During the implementation of the QR codes and video modeling videos, the Betty Brinn Children's Museum will provide the facility to the researcher during the hours while the museum is closed. During the data analysis and assessment phase, activities will be carried out in the R2D2 Lab located at the UW Milwaukee campus. The

computers in this facility are equipped with the NOLDUS Observer which is the software that will be used to analyze the qualitative data.

Limitations

The limitations of this study are that it is only representative of a single demographic. It only studies four children in the Milwaukee area. It also only studies within a single children's museum so it only demonstrates this app used in a grocery store exhibit. Data is only collected while the museum is closed so it does not measure how the children would behave during normal museum hours with the distractions of other children and parents. Finally it does not investigate the use of "ScanDo!" on other cognitive or developmental impairments that may be also benefit from this app.

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Appendix B: Station Video Descriptions

Station 1: Cash Register

A boy playing customer carries a basket of groceries to the register counter and takes them out one by one. As the customer unloads the groceries, the child playing cashier rings them up. After all of the groceries have been rang up, the cashier tells the customer the total and the customer gives him money. The transaction ends with the customer saying "thank you".

Station 2: Aisles

A boy playing customer announces he's making a spaghetti dinner. He gets a cart and pushes it down the aisle. He picks up tomatoes, onions peppers, mozzarella cheese and pasta sauce and puts them each in his cart.

Station 3: Coffee

A boy says "Good Morning, time to make some coffee!" He pours the coffee beans into the coffee grinder and pushes the green button. Then he smells the bag of beans and says "Smells great."

Station 4: Flowers

A girl "I'm going to make a bouquet for my mom for mother's day." She says the color of flowers that she will need as she picks them. She grabs some pink, white and yellow flowers and puts them in the vase at the top of the shelf. Then she smells the bouquet she's made and says "They smell great!"

Station 5: Baking

A girl playing customer asks the girl behind the counter playing baker for a blueberry muffin. The baker explains as she goes that she will need her muffin tin and muffins. Then she will puts them in the oven, pushes the button and takes them out. The baker hands a muffin to the customer and warns her that they are hot.

Station 6: Sandwiches

A boy playing customer asks the girl playing deli worker if he can have a ham sandwich. The deli worker says "yes" and begins making his sandwich. She lists each ingredient as she puts it together including bread, ham, cheese and tomato. She says "Here you go" as she hands the customer his sandwich and the customer thanks her.

Station 7: Soup

A boy announces he will make chili for the football game. He explains that he will pour in salt, pepper and onion as he grabs each of these items from the shelf in front of him. Then he stirs the spoon in the pot. He smells it and says that it "smells great."

Station 8: Truck

A boy walks up to the boy playing driver tells him he needs to deliver the milk jug to another store. The driver thanks him, then sets the milk jug down on the seat next to him. Then the driver spins the steering wheel and makes car noises.

Appendix C: Recruitment Flyer

PARTICIPANTS NEEDED FOR STUDY: Assisting Children with Autism Spectrum Disorder in a Museum Setting

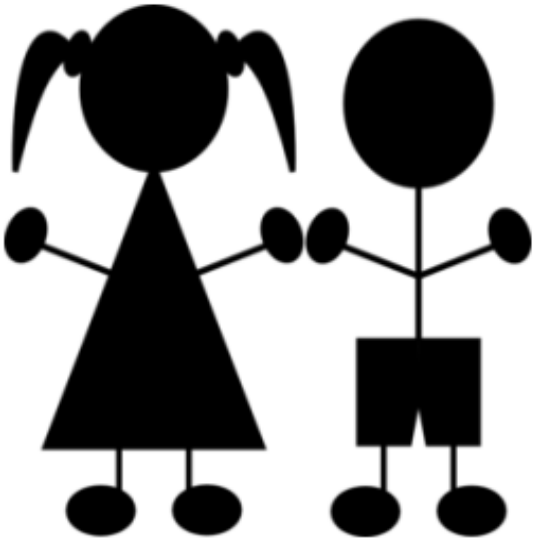
Eligibility: Children who are between the ages of 3 and 12 who have a medical or educational diagnosis of ASD. Family should be English speaking, and child should have used a tablet or smartphone.

Location: The study will take place at the Betty Brinn Childrens Museum.

* Participants will receive free admission and parking.

Participation: Eligible subjects will participate in a pre and post survey at each visit to the museum. The child and their parent will be asked to visit the museum four times for one hour each visit. The child will be given a tablet to use a new mobile application while playing. This application uses video modeling.

*Participants will receive a $50 gift card to Target or Walmart after completing two visits to the museum.



IF INTERESTED PLEASE CONTACT:
Bethany Miota
bmmiota@uwm.edu
(262)853-2916

Please be prepared to provide availability
for museum visits when contacting researcher.

Appendix D: Screening Tool

Name of Parent/ Guardian:

Gender of child:

Age of child:

Please circle your answers to the following questions:

Does your child have a medical or educational diagnosis of Autism Spectrum Disorder? Yes or No

Does your child currently use a smart device already? Yes or No

If yes select the device the child is familiar with: (select all that apply)

- iPad
- iPod
- android,
- other tablet
- Other (Please describe):

How comfortable is your child with using an iPad or tablet?

1 Never used

2 Not comfortable - Only used once or twice

3 Somewhat comfortable

4 Comfortable - Used on several occasions

5 Use Frequently - Very Comfortable

How many hours a day does your child use mobile technology?

- Less than 30 minutes
- 30 minutes to 1 hour
- 1 hour or more

How many hours a day does your child use desktop technology?

- Less than 30 minutes
- 30 minutes to 1 hour
- 1 hour or more

Appendix E: Consent Forms

Child Consent Form

IRB Protocol Number: 16.167

IRB Approval date: December 18, 2015

UNIVERSITY OF WISCONSIN – MILWAUKEE
ASSENT TO PARTICIPATE IN RESEARCH

Study title: Video Modeling to Increase Interaction for Children with Autism Spectrum Disorder in a Museum Setting Using an Application on a Tablet.

Person in Charge of Study: Bethany Miota, B.S., MS Occupational Therapy student at UW Milwaukee

We are doing a research study. A research study is a way to learn more things. We are trying to learn more about using an application that takes pictures and videos on a tablet and let's you watch videos. If you decide that you want to be part of this study, you will be asked to play in the Sendik's exhibit at the Betty Brinn Children's Museum for as long as you'd like while my two assistants and I watch you playing. We would like for you to visit the Sendik's exhibit four different times.

We don't know if this study will help you. We hope to learn something that will help other people some day.

You don't have to be in this study. It is up to you and no one will be mad at you. If you say yes now, but change your mind later, that's okay too. Just let me know.

When we are finished with this study we will write a report about what was learned. This report will not include your name or that you were in the study.

If you decide you want to be in this study, please print and sign your name.

I, _____, want to be in this research study.
(Print your name here)

_____ _____
(Sign your name here) (Date)

Principal Investigator (or Designee)
I have given this research subject information on the study that is accurate and sufficient for the subject to fully understand the nature, risks and benefits of the study.

_____ _____
Printed Name of Person Obtaining Consent Role on Study

_____ _____
Signature of Person Obtaining Consent Date

This Assent Form has been approved by the IRB for a one year period.

Parent Consent Form

Informed Consent Version:

IRB Protocol Number:
IRB Approval Date:

UNIVERSITY OF WISCONSIN – MILWAUKEE
PARENTAL CONSENT FOR CHILD TO PARTICIPATE IN RESEARCH

1. General Information

Study title:
Video Modeling to Increase Interaction for Children with Autism Spectrum Disorder in a Museum Setting Using the "ScanDo!" Application.

Person in Charge of Study (Principal Investigator):
Bethany Miota, B.S., MS Occupational Therapy student at UW Milwaukee

2. Study Description

Your child is being asked to participate in a research study. Your child's participation is completely voluntary. Your child does not have to participate if you do not want him/her to participate.

Study description:
The purpose of this study is to increase the accessibility for families with children diagnosed with Autism by implementing the ScanDo! app in museums. Since children with Autism have a hard time participating in spontaneous play and social interaction, gaining the full experience at exhibits in museums is difficult. The ScanDo! app allows individuals to scan a QR code using a tablet which links them to a YouTube video that demonstrates how to play with the station. By using the ScanDo! app, the child can see a demonstration as many times as they need and will be able to learn more effectively from the exhibit. The study will take place at the Betty Brinn Children's Museum in Milwaukee. There will be approximately 5 subjects and each will need to commit 4 hours to the study in the form of one hour visits that are 1-4 weeks apart.

3. Study Procedures

What will I be asked to do if I participate in the study?
If you agree to allow your child to participate, he or she will be asked to go to the Betty Brinn Children's Museum. Here they will be asked to play in the Sendik's exhibit for up to an hour for each visit. As the parent, you can decide to end the visit whenever you choose for any reason. During all visits, your child will be given a tablet to use as they choose. During all visits, your child will be video-taped. These video-recordings will be watched by the primary investigator and her research assistants to analyze the behavior and interactions demonstrated by your child in the exhibit. If you or your child refuse to be recorded you cannot still participate in this study.

4. Risks and Minimizing Risks

What risks will my child face by participating in this study?

There are no known risks for participating in this research study.

5. Benefits

Will my child receive any benefit from my participation in this study?

There are no benefits to you other than to help the researchers learn something new.

6. Study Costs and Compensation

Will I or my child be charged anything to participate in this study?

You will not be responsible for any of the costs from taking part in this research study.

Will I or my child be paid or given anything for being in the study?

You will be compensated with a $50 gift card to either Walmart or Target at your second visit to the Betty Brinn Children's Museum. Due to UWM policy and IRS regulations, we are required to obtain your name, address, social security number (or tax ID number), and signature, in order to issue the gift card/cash to you. Please note: UWM employees are not eligible to receive payments in the form of gift cards or cash.

7. Confidentiality

What happens to the information collected?
All information collected about your child during the course of this study will be kept confidential to the extent permitted by law. We may decide to present what we find to others, or publish our results in scientific journals or at scientific conferences. Only the PI will have access to the information. However, the Institutional Review Board at UW-Milwaukee or appropriate federal agencies like the Office for Human Research Protections may review your child's study related records. Your child's screening information including their name will be coded and will not be attached to the data that is collected. Your child's screening form, data and this consent form will be stored in a locked cabinet in the R2D2 lab at UWM at Enderis Hall 135, R2D2 Center at 2400 E. Hartford Ave, Milwaukee, WI 53211 for one year for future use.

8. Alternatives

Are there alternatives to participating in the study?

There are no known alternatives available to your child other than not taking part in this study.

9. Voluntary Participation and Withdrawal

What happens if I decide not to allow my child to be in this study?

Your child's participation in this study is entirely voluntary. You may choose not allow your child to take part in this study. If you decide to allow your child take part, you can change your mind later and withdraw him/her from the study. In addition, your child will also be asked whether he/she would like to participate in the research study by reading and signing an assent form which describes the study. Your child will be free to not answer any questions or withdraw at any time. Your and your child's decision will not change any present or future relationships with the University of Wisconsin Milwaukee. If you decide to withdraw from the study, we will use the information collected to that point.

10. Questions

Who do I contact for questions about this study?
For more information about the study or the study procedures or treatments, or to withdraw your child from the study, contact:

Bethany Miota
Department of Occupational Science and Technology
College of Health Sciences
R2D2 Center
Enderis Hall 135
PO Box 413
Milwaukee, WI 53201
(262)853-2916

Who do I contact for questions about my child's rights or complaints about my child's treatment as a research subject?
The Institutional Review Board may ask your name, but all complaints are kept in confidence.

Institutional Review Board
Human Research Protection Program
Department of University Safety and Assurances
University of Wisconsin – Milwaukee
P.O. Box 413
Milwaukee, WI 53201
(414) 229-3173

11. Audio or Video recording or Photographs

Consent to Audio/Video/Photo Recording:

It is okay to videotape my child while he/she is in this study and use my child's videotaped data in the research.

Please initial: ____Yes ____No

12. Signatures

Parental/Guardian Consent:

I have read or had read to me this entire consent form, including the risks and benefits. I have had all of my questions answered. I understand that I may withdraw my child from the study at any time. I am not giving up any legal rights by signing this form. I am signing below to give consent for my child to participate in this study.

_____
Printed Name of Child Participant

_____
Printed Name of Parent/Guardian

_____ _____
Signature of Parent/Guardian Date

Principal Investigator (or Designee)

I have given this research subject information on the study that is accurate and sufficient for the subject to fully understand the nature, risks and benefits of the study.

_____ _____
Printed Name of Person Obtaining Consent Study Role

_____ _____
Signature of Person Obtaining Consent Date

Appendix F: Scripts

Screening Script (Communicated to Participants via Phone)

Hi, my name is Bethany Miota and I'm an occupational therapy student at UWM. I'm doing my master's thesis on an intervention that uses apps in a museum setting. I hope these apps can be an intervention that helps children with Autism access the museum more easily. I really appreciate your interest in this study. All of the information I've collected today and will collect in the future will be kept confidential. Can I ask you a few questions for screening to see if your child will qualify as a participant?

This all looks great. I'm going to review these answers, then get back to you whichever way is best for you. I'll let you know if your child qualifies and if so, I'll offer several dates for us to visit the Betty Brinn Children's Museum together.

Do you have any questions for me at this time?

Okay, if you think of anything please, please call or email me. Thanks again! Have a great day.

Control Introduction Script

Here are my assistants, Jessica Skala and Bekki Schulz. They won't be interacting with you or your child but I'm happy to help you in any way during your trial.

Thank you so much for participating in this study. We are going to start by asking you to take a short survey about yourself and your child. After that I will give you a description of the study and the technology we will be using in the Sendik's exhibit. Then your child will play for 30 minutes in the Sendik's exhibit while myself and my two research assistants watch. Finally I will ask you to fill out a short post-survey. Do you have any questions for me before we get started?

(Answer any questions)

Alright, then I'm going to give you a few minutes to fill out the pre-survey. Your answers should be based on how your day has been so far. Just do the best you can and ask me if you have any questions.

(Give Pre Survey to Caretaker)

Thanks for sharing your answers with us. Now I'm going to describe the app that your child will be using. I'm going to provide you with an iPad Air to access it. The iPad will be in Guided Access mode which is a setting that does not allow the user to exit the app.

The app we are using today will be one that takes pictures and videos. When you hold it up like this you can see the view finder. You can point it at any object or person in the exhibit. To capture a photo push the red button and to take a video hold the red button down. If you push on this circle in the corner you can view the photo or video that you just captured.

I encourage you to use the app at each station. I am fine with either you or your child using the app on the iPad, as long as the intention is to engage your child. Please explore the exhibit using the app and have fun. If you feel that the app is not enhancing your experience feel free to set the iPad down and play as you please.

Since you know your child best, I encourage you to help him/her to participate in the exhibit whichever way you feel is best for him/her. If you feel he/she is engaging in the exhibit well on their own and don't feel it is necessary to participate, feel free to observe instead if you prefer. If you feel they need extra encouragement or assistance to participate, please help them in any way you see fit. Finally if your child becomes upset or has to go to the bathroom, or has any other need that arises, feel free to take a break from the study or terminate it if you feel that is best. In the case of any unexpected termination, please take care of your child first and don't feel the need to consult me.

Please follow me into the exhibit. There, you will see my two research assistants. They will be watching from several feet away to observe and record your child while playing. Are there any other questions that I can answer before we begin?

(Answer any questions)

(30 Minute Trial)

The 30 minutes are up. I'd like you to please fill out the post survey and then you both can play anywhere in the museum that you'd like until it closes at 5pm.

(Give Post Survey to Caretaker)

This looks great! Thank you so much for helping with this study. We'll see you the next time to try a different app. I hope you and your child had fun!

Intervention Introduction Script

Here are my assistants, Jessica Skala and Bekki Schulz. They won't be interacting with you or your child but I'm happy to help you in any way during your trial.

Thank you so much for participating in this study. We are going to start by asking you to take a short survey about yourself and your child. After that I will give you a description of the study and the technology we will be using in the Sendik's exhibit. Then your child will play for 30 minutes in the Sendik's exhibit while myself and my two research assistants watch. Finally I will ask you to fill out a short post-survey. Do you have any questions for me before we get started?

(Answer any questions)

Alright, then I'm going to give you a few minutes to fill out the pre-survey. Your answers should be based on how your day has been so far. Just do the best you can and ask me if you have any questions.

(Give Pre Survey to Caretaker)

Thanks for sharing your answers with us. Now I'm going to describe the app that your child will be using. I'm going to provide you with an iPad Air to access it. The iPad will be in Guided Access mode which is a setting that does not allow the user to exit the app.

The app we are using today will be one that scans QR codes that are located throughout the exhibit. You can find the QR code in the viewfinder. Once you scan the QR code, a video will pop up of children demonstrating how to play at that station. Just push the play button to start the video. Then just use the back button, and push the Scan It button to get back to the viewfinder.

I encourage you to use the app at each station. I am fine with either you or your child using the app on the iPad, as long as the intention is to engage your child. Please explore the exhibit using the app and have fun. If you feel that the app is not enhancing your experience feel free to set the iPad down and play as you please.

Since you know your child best, I encourage you to help him/her to participate in the exhibit whichever way you feel is best for him/her. If you feel he/she is engaging in the exhibit well on their own and don't feel it is necessary to participate, feel free to observe instead if you prefer. If you feel they need extra encouragement or assistance to participate, please help them in any way you see fit. Finally if your child becomes upset or has to go to the bathroom, or has any other need that arises, feel free to take a break from the study or terminate it if you feel that is best. In the case of any unexpected termination, please take care of your child first and don't feel the need to consult me.

Please follow me into the exhibit. There, you will see my two research assistants. They will be watching from several feet away to observe and record your child while playing. Are there any other questions that I can answer before we begin?

(Answer any questions)

(30 Minute Trial)

The 30 minutes are up. I'd like you to please fill out the post survey and then you both can play anywhere in the museum that you'd like until it closes at 5pm.

(Give Post Survey to Caretaker)

This looks great! Thank you so much for helping with this study. We'll see you the next time to try a different app. I hope you and your child had fun!

Appendix G: Caretaker Pre Survey and Post Survey

Caretaker Pre Survey

Participant #: _____ Visit #: 1 2 3 4 5 Date: _____

Please CIRCLE a number that describes your child's behaviors prior to your visit today compared to your child's typical day.

How well was your child's regular routine followed so far today?	**0 1 2 3 4 5** **Not at All Some Very Much**
How disrupted was your child by an event or situation that happened earlier today?	**0 1 2 3 4 5** **Not at All Some Very Much**
How calm was your child so far today?	**0 1 2 3 4 5** **Not at All Some Very Much**
How energetic was your child so far today?	**0 1 2 3 4 5** **Tired Some Hyperactive**
How alert and attentive was your child so far today?	**0 1 2 3 4 5** **Distracted Very Focused**
How disruptive has your child's behavior been today? (i.e. yelling, throwing, etc.)	**0 1 2 3 4 5** **Not at All Some Very Much**
Additional Comments:	

More On Other Side ➔

Please CIRCLE a number that describes your child's behaviors right now compared to your child's typical day.

How much difficulty does your child have maintaining focus?	**0 1 2 3 4 5** **Not at All Some Very Much**
How fixated on a specific topic, activity or object is your child?	**0 1 2 3 4 5** **Not at All Some Very Much**
How much difficulty is your child having transitioning to a new setting or activity?	**0 1 2 3 4 5** **Not at All Some Very Much**
How much aggressive or disruptive behavior is your child engaging in? (i.e. yelling, throwing)	**0 1 2 3 4 5** **Not at All Some Very Much**
How much communication is your child using? (i.e. spoken words or sounds, pictures, sign language, etc.)	**0 1 2 3 4 5** **Not at All Some Very Much**
How well is your child able to focus?	**0 1 2 3 4 5** **Not at All Some Very Much**
How well is your child able to engage in play?	**0 1 2 3 4 5** **Not at All Some Very Much**
How much sensory regulation does your child need today compared to a typical day? (i.e. oral stimulation, deep pressure, movement, etc.)	**0 1 2 3 4 5** **Not at All Some Very Much**
Additional Comments:	

Caretaker Post Survey

Participant #: _____ Visit #: 1 2 3 4 5 Date: _____

Please CIRCLE a number that describes your child's behaviors right now compared to your child's typical day.

How much difficulty does your child have maintaining focus?	**0 1 2 3 4 5** **Not at All Some Very Much**
How fixated on a specific topic, activity or object is your child?	**0 1 2 3 4 5** **Not at All Some Very Much**
How much difficulty is your child having transitioning to a new setting or activity?	**0 1 2 3 4 5** **Not at All Some Very Much**
How much aggressive or disruptive behavior is your child engaging in? (i.e. yelling, throwing)	**0 1 2 3 4 5** **Not at All Some Very Much**
How much communication is your child using? (i.e. spoken words or sounds, pictures, sign language, etc.)	**0 1 2 3 4 5** **Not at All Some Very Much**
How well is your child able to focus?	**0 1 2 3 4 5** **Not at All Some Very Much**
How well is your child able to engage in play?	**0 1 2 3 4 5** **Not at All Some Very Much**
How much sensory regulation does your child need today compared to a typical day? (i.e. oral stimulation, deep pressure, movement, etc.)	**0 1 2 3 4 5** **Not at All Some Very Much**
Additional Comments:	

More On Other Side ➜

Please CIRCLE a number that describes your child's behavior during your 30 minute visit to the Betty Brinn.

How comfortable was your child with using the tablet?	0 1 2 3 4 5 Not at All Some Very Much
How comfortable were you with using the tablet?	0 1 2 3 4 5 Not at All Some Very Much
How well was your child able to pay attention while using the tablet?	0 1 2 3 4 5 Not at All Some Very Much
How effective was the use of the iPad app was for engaging your child with the exhibit?	0 1 2 3 4 5 Not at All Some Very Helpful
How effective was the use of the iPad app for engaging your child with you, their siblings or a peer?	0 1 2 3 4 5 Not at All Some Very Helpfu
How effective was the technology in increasing the quality of your child's experience?	0 1 2 3 4 5 Not at All Some Very Much
How much did you help your child while using the technology?	0 1 2 3 4 5 Not at All Some Very Much
How easy was it to use the iPad app?	0 1 2 3 4 5 Very Confusing Very Intuitive
How easy was it to learn how to use the iPad app?	0 1 2 3 4 5 Very Confusing Very Intuitive
Suggested Improvements for App and Exhibit:	
Additional Comments:	

Appendix H: Quantitative Data Collection Form

Observer's Name: ______________________________________ **Date:** ______________

Participant #: _________________ **Participant's Visit #: 1 2 3 4 5**

Register **Coffee** **Baking** **Soup**
Cart/Aisles **Flowers** **Sandwich** **Truck**

On Task												
Off Task												
Technology												

Register **Coffee** **Baking** **Soup**
Cart/Aisles **Flowers** **Sandwich** **Truck**

On Task												
Off Task												
Technology												

Register **Coffee** **Baking** **Soup**
Cart/Aisles **Flowers** **Sandwich** **Truck**

On Task												
Off Task												
Technology												

Register **Coffee** **Baking** **Soup**
Cart/Aisles **Flowers** **Sandwich** **Truck**

On Task												
Off Task												
Technology												

Register **Coffee** **Baking** **Soup**
Cart/Aisles **Flowers** **Sandwich** **Truck**

On Task												
Off Task												
Technology												

Register **Coffee** **Baking** **Soup**
Cart/Aisles **Flowers** **Sandwich** **Truck**

On Task												
Off Task												
Technology												

<u>On-Task Behavior</u>

Looking at station or toy

Producing **words, sounds or gestures** related to exhibit

Transitioning and **moving** with intention towards toy or station

Appendix I: Qualitative Data Collection Form

Observer's Name: _____ **Date:** _____

Participant #: _____ **Visit #:** 1 2 3 4 5

Demeanor of Child	**Demeanor of Parent**
Energy Level: 1 2 3 4 5 Tired Average Hyperactive	Energy Level: 1 2 3 4 5 Tired Average Hyperactive
Emotional Status: 1 2 3 4 5 Agitated or Sad Happy and Content	Emotional Status: 1 2 3 4 5 Agitated or Sad Happy and Content
Focus of Attention: (Objects, People, etc.)	Focus of Attention: (Objects, People, etc.)

Play Behaviors and Actions Observed (running with cart, picking up fruit, etc.)

Gross Motor:

Fine Motor:

Imitation of app, adult or peer:

Others:

Interaction With Technology

Quality of Child's Interaction with App:

1 Unproductive — 2 — 3 Occasionally Appropriate and Productive — 4 — 5 Intentional and Productive

1 Annoyed or Hostile — 2 — 3 — 4 — 5 Mutually Happy

Attitude Towards Technology:

Caretaker:

1 Withdrawn and Resistant — 2 — 3 — 4 — 5 Engaging and Encouraging Child to Use App

Child:

1 Withdrawn and Resistant to Tablet Use — 2 — 3 — 4 — 5 Engaged with Tablet

Unordinary Behaviors or Events

(includes accident or illness, malfunction of equipment, etc.)

Interactions Between Child and Parent or Peer

Quality of Interaction:

1 2 3 4 5
Unproductive — Intentional and Productive

1 2 3 4 5
Annoyed or Hostile — Mutually Happy

Attitude of Each Person in Interaction:

Caretaker:

1 2 3 4 5
Withdrawn and Resistant — Engaging and Encouraging

Child:

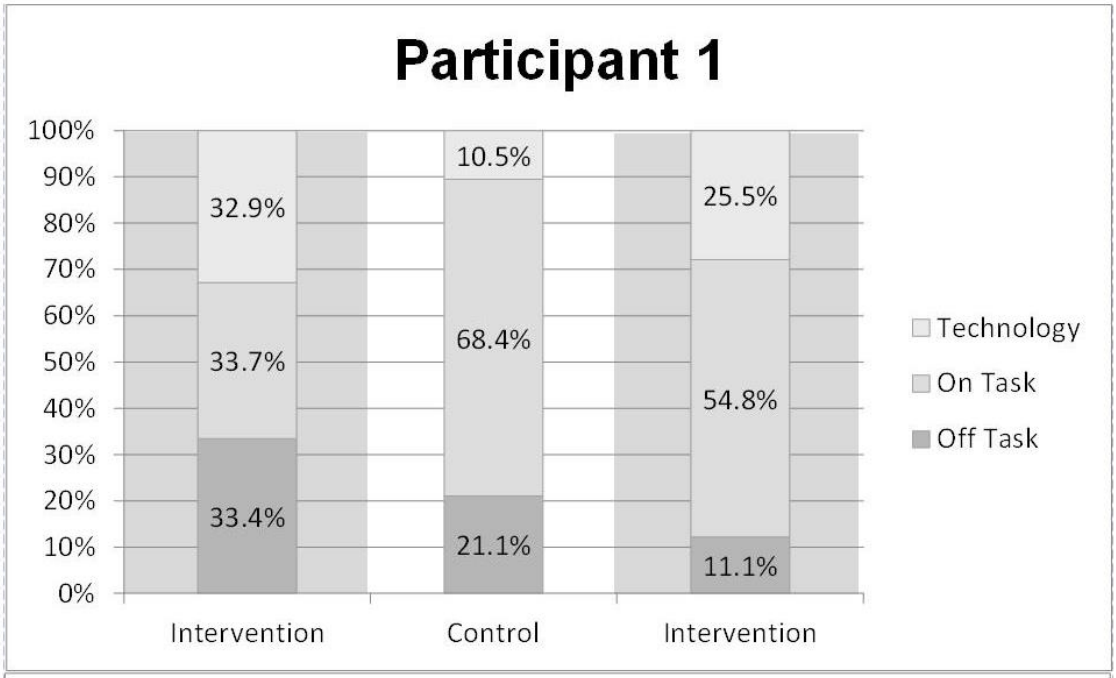
1 2 3 4 5
Withdrawn and Resistant — Engaging and Encouraging

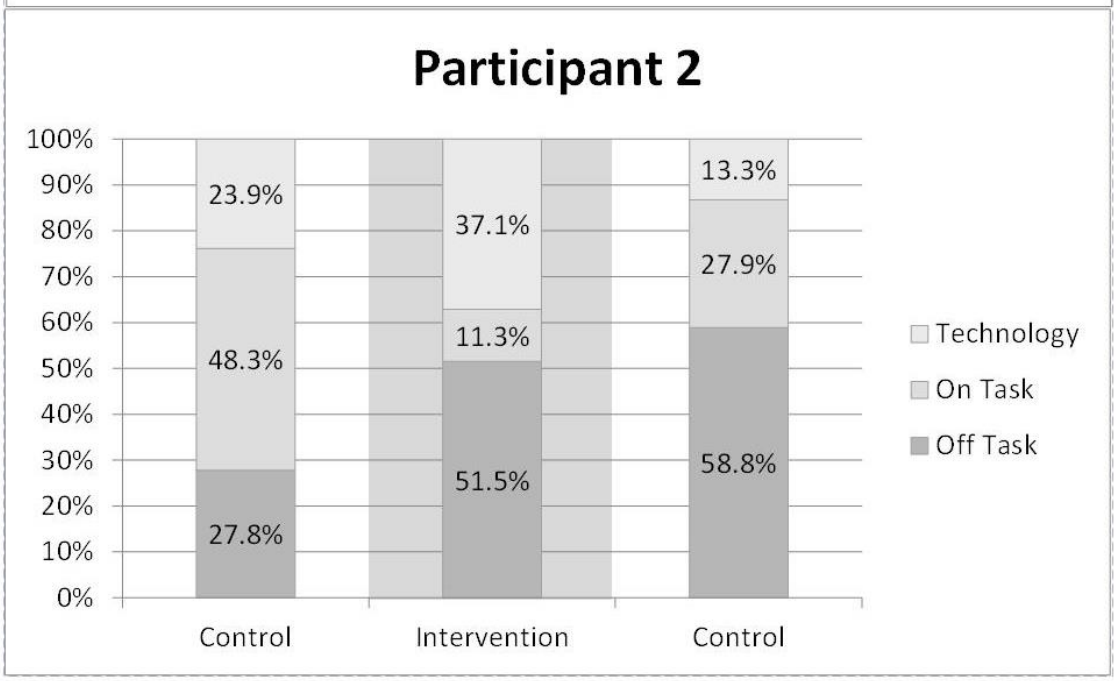
Peer/Sibling:

1 2 3 4 5
Withdrawn and Resistant — Engaging and Encouraging

Examples of Communication Strategies Observed with Caretaker	**Examples of Communication Strategies Observed with Peer or Sibling**
Verbal (# of words, clarity of speech, etc.):	Verbal (# of words, clarity of speech, etc.):
Facial Expressions (eye contact, smile, etc.):	Facial Expressions (eye contact, smile, etc.):
Gestures (pointing, leading by hand, etc.):	Gestures (pointing, leading by hand, etc.):
Other:	Other:

Appendix J: Supporting Graphs





Gray Background Indicates Intervention Phase

Appendix K: IRB

IRBManager Protocol Form

NOTE: If you are unsure if your study requires IRB approval, please review the UWM IRB Determination Form.

Instructions: Each Section must be completed unless directed otherwise. Incomplete forms will delay the IRB review process and may be returned to you. Enter your information in the colored boxes or place an "X" in front of the appropriate response(s). If the question does not apply, write "N/A."

SECTION A: Title

A1. Full Study Title: Video Modeling to Increase Interaction for Children with Autism Spectrum Disorder in a Museum Setting Using an Application on a Tablet.

SECTION B: Study Duration

B1. What is the expected start date? *Data collection, screening, recruitment, enrollment, or consenting activities may not begin until IRB approval has been granted. Format: 07/05/2011*

12/15/2015

B2. What is the expected end date? *Expected end date should take into account data analysis, queries, and paper write-up. Format: 07/05/2014*

12/31/2017

SECTION C: Summary

C1. Write a brief descriptive summary of this study in Layman Terms (non-technical language):

This study will invite children with Autism Spectrum Disorder (ASD) to be participants and to use the ScanDo! application in a children's museum setting. The ScanDo! application will be accessed on a smartphone or tablet. It allows the user to take a photo of a QR code (barcode) which will link the user to a video of a child modeling the appropriate way to interact with the museum exhibit. Each participant and their parent/guardian will visit the children's museum once to establish baseline, a second time to use the ScanDo! application, a third time to revisit baseline and a final time to revisit the ScanDo! application intervention. All visits will be video recorded to determine quantify the appropriate gestures and words used. Parents will also complete surveys before and after each visit to describe their opinion of their child's behavior and the ScanDo! application.

C2. Describe the purpose/objective and the significance of the research:

The purpose of this study is to determine if the ScanDo! application is an assistive technology that increases interaction for children with Autism Spectrum Disorder (ASD) in a museum setting. This study contributes to the research supporting the implementation of an assistive technology that utilizes video modeling in situ strategy for the benefit of children with ASD in the community.

C3. Cite the most relevant literature pertaining to the proposed research:

Bellini, S., & Akullian, J. (2007). A meta-analysis of video modeling and video self-modeling interventions for children and adolescents with autism spectrum disorders.(brief article). Exceptional Children, 73(3), 264.

Cardon, T. A., & Wilcox, M. J. (2011). Promoting imitation in young children with autism: A comparison of reciprocal imitation training and video modeling. Journal of Autism and Developmental Disorders, (5), 654-666. doi:10.1007/s10803-010-1086-8

Haworth, A., & Williams, P. (2012). Using QR codes to aid accessibility in a museum. Journal of Assistive Technologies, 6(4), 285-291. doi:10.1108/17549451211285771

Macdonald, R., Clark, M., Garrigan, E., & Vangala, M. (2005). Using video modeling to teach pretend play to children with autism. Behavioral Interventions; Behav.Intervent., 20(4), 225-238. doi:10.1002/bin.197

Schultz, M. K. (2013). A case study on the appropriateness of using quick response (QR) codes in libraries and museums. Library & Information Science Research, 35(3), 207-215.

Shah, N. (2011). Special education pupils find learning tool in iPad applications. Education Week, 30(22), 1-16.

Sung, Y., Hou, H., Liu, C., & Chang, K., (2010). Mobile guide system using problem-solving strategy for museum learning: A sequential learning behavioural pattern analysis. Journal of Computer Assisted Learning, 26(2), 106-115. doi:10.1111/j.1365-2729.2010.00345.x

Nikopoulos, C. K., & Keenan, M. (2003). Promoting social initiation in children with autism using video modeling. Behavioral Interventions, 18(2), 87-108. doi:10.1002/bin.129

Yee, H. S. S. (2012). Mobile technology for children with autism spectrum disorder: Major trends and issues doi:10.1109/IS3e.2012.6414954

SECTION D: Subject Population

Section Notes...

- D1. If this study involves analysis of de-identified data only (i.e., no human subject interaction), IRB submission/review may not be necessary. Please review the UWM IRB Determination Form for more details.

D1. Identify any population(s) that you will be specifically targeting for the study. Check all that apply: (Place an "X" in the column next to the name of the special population.)

Existing Dataset(s)	Institutionalized/ Nursing home residents recruited in the nursing home
UWM Students of PI or study staff	Diagnosable Psychological Disorder/Psychiatrically impaired
UWM Students (but not of PI or study staff)	Decisionally/Cognitively Impaired
Non-UWM students to be recruited in their educational setting, i.e. in class or at school	Economically/Educationally Disadvantaged
UWM Staff or Faculty	Prisoners
Pregnant Women/Neonates	International Subjects (residing outside of the US)

	Minors under 18 and ARE NOT wards of the State		Non-English Speaking
	Minors under 18 and ARE wards of the State		Terminally ill
X	Other (Please identify): Children with Autism Spectrum Disorder between ages 3 and 12		

D2. Describe the subject group and enter the total number to be enrolled for each group. For example: teachers-50, students-200, parents-25, student control-30, student experimental-30, medical charts-500, dataset of 1500, etc. Then enter the total number of subjects below. Be sure to account for expected drop outs. For example, if you need 100 subjects to complete the entire study, but you expect 5 people will enroll but "drop out" of the study, please enter 105 (not 100).

Describe subject group:	Number:
Children with Autism Spectrum Disorder between ages 3 and 12	5
TOTAL # OF SUBJECTS:	5
TOTAL # OF SUBJECTS (If UWM is a collaborating site for a multi institutional project):	5

D3. For each subject group, list any major inclusion and exclusion criteria (e.g., age, gender, health status/condition, ethnicity, location, English speaking, etc.) and state the justification for the inclusion and exclusion criteria:

Inclusion criteria are English as a primary language of the child, an educational or medical diagnosis of Autism Spectrum Disorder, at least 3 years of age, and younger than 13 years of age. The justification for the age inclusion criteria is that this is the estimated appropriate age for this exhibit. The justification for the inclusion criteria for primary language is that the videos will be in English.

Exclusion criteria are the child having never used a smartphone or tablet, and the child being visually or hearing impaired. The justification for the exclusion criterion is that the participant should be familiar with the technology used in this study and able to see and hear the videos.

SECTION E: Study Activities: Recruitment, Informed Consent, and Data Collection

Section Notes...

- Reminder, all recruitment materials, consent forms, data collection instruments, etc. should be attached for IRB review.
- The IRB welcomes the use of flowcharts and tables in the consent form for complex/ multiple study activities.

In the table below, chronologically describe all study activities where human subjects are involved.

- In **column A**, give the activity a short name. Please note that Recruitment, Screening, and consenting will be activities for almost all studies.

A. Activity Name:	B. Person(s) Conducting Activity	C. Activity Description (Please describe any forms used):	D. Activity Risks and Safeguards:
Recruitment	Possible candidates will contact the research team. (The research team consists of Bethany Miota (PI), Dr. Roger Smith (the PI's advisor), and 2-3 student research Assistants who have yet to be selected.)	Recruitment will occur via phone, email or flyer with different autism organizations in the Milwaukee area, practitioners and the Betty Brinn Children's Museum. If interested, potential participants will contact a member of the research team via phone or email, who will convey information to potential participants. If eligible, they will continue on with the study. Recruitment will take place in the Fall of 2015 and Summer and Fall of 2016.	Minimal
Screening and Scheduling	Members of the research team will administer the screening process.	All participants will complete the screening in person or on the phone during their initial contact to the research team using the attached screening tool document. The researcher will also obtain contact and scheduling information from the individual at this time, and provide information for participating in the study.	Risk: Personal demographic and contact information will be collected. Safeguard: Only the primary researcher will have access to personal and contact information which will be kept on a password protected, locked server or in a locked cabinet. The museum will be closed when the participants are being video recorded so nonparticipants will not be recorded.
Obtaining Consent	The researcher team will obtain the consent from the parents of the children.	Participants and their parent/guardian will read and sign an informed assent form during their first visit to the Betty Brinn Children's Museum. This will occur prior to any data collection. If the child is unable to read, the parent will read it to them. If the parent does not feel that the child can understand the form or the process or	Minimal

Obtaining Consent	The researcher team will obtain the consent from the parents of the children.	Participants and their parent/guardian will read and sign an informed assent form during their first visit to the Betty Brinn Children's Museum. This will occur prior to any data collection. If the child is unable to read, the parent will read it to them. If the parent does not feel that the child can understand the form or the process or assent, then the child will not be required to sign this form.	Minimal
Baseline Trials	Children and caregiver will utilize the application.	At the beginning of the visit, the parent/guardian will complete a presurvey about their child's behavior. Each participant and their parent/guardian will be given an introduction by a member of the research team explaining the layout of the exhibit. Each child will be given a tablet with a camera application on it. The participant and their parent/guardian will be given up to 30 minutes to play in the exhibit and are free to leave whenever they would like. The participants will be observed by the primary investigator and two research assistants for the duration of their visit to the exhibit. The research assistants will complete the quantitative field notes during the 30 minute trials. After the visit, the parent will be given a post-survey about their child's behavior. Members of the research team will use field notes similar to the attached qualitative field notes document to observe the	Risk: Personal demographic information and video recordings will be collected. Safeguard: Only the primary researcher will have access to personal and contact information which will be kept on a password protected, locked server or in a locked cabinet in R2D2. The video recordings on the camera will be transported in an automobile by Bethany Miota to the R2D2 lab immediately after trials. Then the videos will be transferred from the camera to the password protected computer electronically or manually. The data on the camera will then be immediately deleted.

		participants and record data during the trials. There will be two visits total for baseline trials.	
Intervention Trials	Children and caregiver will utilize the application.	At the beginning of the visit, the parent/guardian will complete a presurvey about their child's behavior. Each participant and their parent/guardian will be given an introduction by a member of the research team explaining the layout of the exhibit and the ScanDo! application. The ScanDo! application is an application that allows the user to take a picture of a QR code. Then the application links it to a video so that the user can instantly watch the video for that code. Each child will be given a tablet with the ScanDo! application on it. The participant and their parent/guardian will be given up to 30 minutes to play in the exhibit and are free to leave whenever they would like. The participants will be observed by the primary investigator and two research assistants for the duration of their visit to the exhibit. . The research assistants will complete the quantitative field notes during the 30 minute trials. After the visit, the parent will be given a post-survey about their child's behavior and the ScanDo! application. Members of the research team will use field notes similar to the attached qualitative field notes document to observe the participants and record data during the trials. There will be two visits total for intervention trials.	Risk: Personal demographic information and video recordings will be collected. Safeguard: Only the primary researcher will have access to personal and contact information which will be kept on a password protected, locked server or in a locked cabinet in R2D2.

Data Analysis	The research team will analyze the videos, field notes and surveys.	The data from observations from research assistant quantitative field notes will be analyzed by the primary investigatory. These will also be analyzed visually and with the two-standard deviation, C-Statistic and celebration line methods. Qualitative data from the participant surveys and research assistant qualitative field notes will be analyzed visually.	Risk: Personal demographic information, surveys, field notes and video recordings will be analyzed. Safeguard: All data will be coded and analysis will be conducted in the R2D2 lab. Security of the data will be maintained through locked cabinets, coded data and password-protected computers.

E2. Explain how the data will be analyzed or studied (i.e. quantitatively or qualitatively) and how the data will be reported (i.e. aggregated, anonymously, pseudonyms for participants, etc.):

The data will be analyzed quantitatively and qualitatively. The surveys completed by parents and the qualitative field notes will be analyzed qualitatively. The quantitative field notes will be analyzed quantitatively. The data will be reported anonymously.

SECTION F: Data Security and Confidentiality

Section Notes...

- Please read the IRB Guidance Document on Data Confidentiality for more details and recommendations about data security and confidentiality.

F1. Explain how study data/responses will be stored in relation to any identifying information (name, birthdate, address, IP address, etc.)? Check all that apply.

[ ] Identifiable - **Identifiers are collected and stored with study data.**
[X] Coded - **Identifiers are collected and stored separately from study data, but a key exists to link data to identifiable information.**
[ ] De-identified - **Identifiers are collected and stored separately from study data without the possibility of linking to data.**
[ ] Anonymous - **No identifying information is collected.**

If more than one method is used, explain which method is used for which data.

N/A

F2. Will any recordings (audio/video/photos) be done as part of the study?

[ ] **Yes**
[X] **No [SKIP THIS SECTION]**

[X] No [SKIP THIS SECTION]

If yes, explain what activities will be recorded and what recording method(s) will be used. Will the recordings be used in publications or presentations?

F3. In the table below, describe the data storage and security measures in place to prevent a breach of confidentiality.

- In **column A**, clarify the type of data. Examples may include screening data, paper questionnaires, online survey responses, EMG data, audio recordings, interview transcripts, subject contact information, key linking Study ID to subject identifiers, etc.
- In **column B**, describe the storage location. Examples may include an office in Enderis 750, file cabinet in ENG 270, a laptop computer, desktop computer in GAR 420, Qualtrics servers, etc.
- In **column C**, describe the security measures in place for each storage location to protect against a breach of confidentiality. Examples may include a locked office, encrypted devices, coded data, non-networked computer with password protection, etc.
- In **column D**, clarify who will have access to the data.
- In **column E**, explain when or if data will be discarded.

A. Type of Data	B. Storage Location	C. Security Measures	D. Who will have access	E. Estimated date of disposal
Pre and Post Surveys, Quantitative Field Notes and Qualitative Field Notes	R2D2 Computer/ File cabinet	The pre and post surveys will not have names or identifiable information on them. They will be kept in a locked cabinet in R2D2.	The Research Team, except for the Research Assistants, will have access to these surveys.	December 2020

F4. Will data be retained for uses beyond this study? If so, please explain and notify participants in the consent form.

No data will be retained for uses beyond this study.

SECTION G: Benefits and Risk/Benefit Analysis

Section Notes...

- Do not include Incentives/ Compensations in this section.

G1. Describe any benefits to the individual participants. If there are no anticipated benefits to the subject directly, state so. Describe potential benefits to society (i.e., further knowledge to the area of study) or a specific group of individuals (i.e., teachers, foster children).

The individual children could benefit from this intervention if it is shown to be effective. If ScanDo! is effective, the children will be able to better fulfill tasks while visiting the museum, and as the application grows, more tasks. They will be able to go to a location, scan the desired bar code, watch an instructional video, and then complete the task. This process could take away all of the prompts that are required of caregivers and can potentially increase the interaction between the caregivers and the child.

G2. Risks to research participants should be justified by the anticipated benefits to the participants or society. Provide your assessment of how the anticipated risks to participants and steps taken to minimize these risks (as described in Section E), balance against anticipated benefits to the individual or to society.

The potential risk for the study includes personal information regarding the children involved. This information will be coded and locked so that only the researchers will be able to access the information. This risk is very minimal for the potential the application has on improving the children's independence.

SECTION H: Subject Incentives/ Compensations

Section Notes...

- H2 & H3. The IRB recognizes the potential for undue influence and coercion when extra credit is offered. The UWM IRB, as also recommended by OHRP and APA Code of Ethics, agrees when extra credit is offered or required, prospective subjects must be given the choice of an equitable, non-research alternative. The extra credit value and the non-research alternative must be described in the recruitment material and the consent form.
- H4. If you intend to submit to Accounts Payable for reimbursement purposes make sure you understand the UWM "Payments to Research Subjects" Procedure 2.4.6 and what each level of payment confidentiality means (click here for additional information).

H1. Does this study involve incentives or compensation to the subjects? For example cash, class extra credit, gift cards, or items.

[X] **Yes**
[ ] **No [SKIP THIS SECTION]**

H2. Explain what (a) the item is, (b) the amount or approximate value of the item, and (c) when it will be given. For extra credit, state the number of credit hours and/or points. (e.g., $5 after completing each survey, subject will receive [item] even if they do not complete the procedure, extra credit will be award at the end of the semester):

The research team is looking to secure funding so the families can receive approximately $5 for parking at the Betty Brinn Childrens Museum, and approximately a $50 gift card after finishing the study to either Target or Walmart. The Betty Brinn Childrens Museum and UW Milwaukee have an agreement to give free admission to the research team and to participants.

H3. If extra credit is offered as compensation/incentive, please describe the specific alternative activity which will be offered. The alternative activity should be similar in the amount of time involved to complete and worth the same number of extra credit points/hours. Other research studies can be offered as additional alternatives, but **a non-research alternative is required.**

N/A

UNIVERSITY of WISCONSIN
UWMILWAUKEE
Department of University Safety & Assurances

Melody Harries
IRB Administrator
Institutional Review Board
Engelmann 270
P. O. Box 413
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http://www.irb.uwm.edu
harries@uwm.edu

Modification/Amendment - IRB Expedited Approval

Date: July 21, 2016

To: Roger Smith, PhD
Dept: Occupational Science and Technology

CC: Bethany Miota

IRB#: 16.167
Title: Video Modeling to Increase Interaction for Children with Autism Spectrum Disorder in a Museum Setting Using an Application on a Tablet

After review of your research protocol by the University of Wisconsin – Milwaukee Institutional Review Board, your protocol has received modification/amendment approval for:

- Title change
- Removing video recordings
- New data collection tools
- Changing amount of time children spend in the exhibit
- Amended study dates

IRB approval will expire on **December 17, 2016**. If you plan to continue any research related activities (e.g., enrollment of subjects, study interventions, data analysis, etc.) past the date of IRB expiration, a Continuation for IRB Approval must be filed by the submission deadline. If the study is closed or completed before the IRB expiration date, please notify the IRB by completing and submitting the Continuing Review form in IRBManager.

Any proposed changes to the protocol must be reviewed by the IRB before implementation, unless the change is specifically necessary to eliminate apparent immediate hazards to the subjects. The principal investigator is responsible for adhering to the policies and guidelines set forth by the UWM IRB, maintaining proper documentation of study records and promptly reporting to the IRB any adverse events which require reporting. The principal investigator is also responsible for ensuring that all study staff receive appropriate training in the ethical guidelines of conducting human subjects research.

As Principal Investigator, it is also your responsibility to adhere to UWM and UW System Policies, and any applicable state and federal laws governing activities which are independent of IRB review/approval (e.g., FERPA, Radiation Safety, UWM Data Security, UW System policy on Prizes, Awards and Gifts, state gambling laws, etc.). When conducting research at institutions outside of UWM, be sure to obtain permission and/or approval as required by their policies.

Contact the IRB office if you have any further questions. Thank you for your cooperation, and best wishes for a successful project.

Respectfully,
Melody Harries
Melody Harries
IRB Administrator

UNIVERSITY of WISCONSIN
UWMILWAUKEE
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Modification/Amendment - IRB Expedited Approval

Date: September 12, 2016

To: Roger Smith, PhD
Dept: Occupational Science and Technology

CC: Bethany Miota

IRB#: 16.167
Title: Video Modeling to Increase Interaction for Children with Autism Spectrum Disorder in a Museum Setting Using an Application on a Tablet

After review of your research protocol by the University of Wisconsin – Milwaukee Institutional Review Board, your protocol has received modification/amendment approval for:

- Adding gift card receipt

IRB approval will expire on **December 17, 2016**. If you plan to continue any research related activities (e.g., enrollment of subjects, study interventions, data analysis, etc.) past the date of IRB expiration, a Continuation for IRB Approval must be filed by the submission deadline. If the study is closed or completed before the IRB expiration date, please notify the IRB by completing and submitting the Continuing Review form in IRBManager.

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As Principal Investigator, it is also your responsibility to adhere to UWM and UW System Policies, and any applicable state and federal laws governing activities which are independent of IRB review/approval (e.g., FERPA, Radiation Safety, UWM Data Security, UW System policy on Prizes, Awards and Gifts, state gambling laws, etc.). When conducting research at institutions outside of UWM, be sure to obtain permission and/or approval as required by their policies.

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Respectfully,
Melody Harries
Melody Harries
IRB Administrator

Appendix L: Equivalent Text Descriptions

Figure 1

Brief Description: Using the ScanDo! App on a Tablet

Summary Description: These two photos seek to show what it looks like for a user to use the ScanDo! app to first scan a QR code and then to view the resulting video that is displayed. The photo on the left shows a ScanDo! app user holding a tablet with the screen pointed at the QR code on the wall. The QR code on the wall is on a yellow sheet of paper for visibility. The entire tablet screen shows the image of this QR code because it is scanning it using the view finder. The photo on the right shows the result of the screen which is a YouTube video with the title of the video underneath it. There is a red play button in the middle of the video for the user to push if they would like to view the video.

Figure 2

Brief Description: Example of a Completed Quantitative Data Collection Form

Summary Description: An excerpt from a completed data collection form shows the station the participant is at and whether they were on-task, off-task or using technology. It does so by having a table with 12 columns with three rows labeled “On-Task,” “Off Task” and “Technology” so that the recorder can choose every ten seconds and record it by making a mark. There are several of these tables on one form so that if a whole table is completed, it shows that 120 seconds or two minutes has passed. After two minutes, the data collector can go to the next table and begin. At the top of each table are the names of the eight stations so that the data collector can circle which one the participant is at. If the participant switches stations, the data collector begins a new

table and marks the new location by circling the station. This figure specifically shows that the participant was at the Register station for 3 minutes and 40 seconds.

Figure 3

Brief Description: Map of grocery store exhibit with stations labeled by number

Summary Description: The map of the grocery store exhibit is labeled with eight stations. The room is a rectangle 25 feet wide and 50 feet long. The entrance is also an exit and it is located at the bottom of the map near to station 1. Station 8 is near the window which is at the top of the map. The key shows the station each number correlates to. The eight stations starting with one are: register, aisles, coffee, flowers, bakery, sandwich, soup, truck.

Figure 4

Brief Description: Example of video model with still frame and description

Summary Description: This photo shows one of eight video models with a text description next to it. The photo shows a boy sitting at a register and another boy on the other side of the checkout counter handing him a dollar bill. The text reads:

> The boy playing customer carries a basket of groceries to the register counter and takes them out one by one. As the customer unloads the groceries, the child playing cashier rings them up. After all of the groceris have been rang up, the cashier tells the customer the total and the customer gives him money. The transaction ends with the customer saying thank you.

Figure 5

Brief Description: Graph of participant’s time at each station

Summary Description: This figure shows a column graph of the amount of time each participant spent at each station during each phase of the study. Participant 1 was at the bakery station for 10.4 minutes during the control phase which is significantly higher than then 4.8 minutes at the aisles station and the 4.4 minutes at the flower station which were the next highest stations. In contrast, the first intervention phase has the three highest stations at 6.7 minutes at the aisles and sandwich stations, and 5.8 minutes at the register station. The second intervention phase shows the three highest stations as 7.1 minutes at the register, 6.8 minutes at the bakery and 6 minutes at the truck.

The top three stations during the control phase for participant 2 were 7.4 minutes at the truck, 4.5 minutes at the aisles and 2.2 minutes at the sandwich with no time spent at the coffee, flowers or bakery stations. In contrast all stations were visited in the intervention phase with the top three being 5.1 minutes at the truck, 3.3 minutes at the aisles, and 2.5 minutes at the soup station. The second control phase shows the top three stations were 9.4 minutes at the truck, 5 minutes in the aisles, and 1.5 minutes at the soup station with no time spent at the register, coffee or flowers station.

Figure 6

Brief Description: Pie charts showing fraction trial spent at each station

Summary Description: This figure shows 6 pie charts, one for each of the three phases for both participants. For participant 1, the control phase shows that 37% of the trial was spent at the bakery whereas during the intervention phases the participant only spent 10% and 19% of the trial at the bakery. For participant 2, the two control phases show that 50% and 54% were spent at the truck. During the intervention phase

however, only 31% of the time was spent at the truck. In addition, the intervention phase shows a slice of the pie chart for all eight stations whereas during both control phases, the participant only visited five of the eight stations.

Figure 7

Brief Description: Line graph of the chronological location

Summary Description: This line graph shows where each participant was during each of their trials. It shows that the total amount of time spent at each station was often divided between more than one visit during each trial. Participant 1 returned to the baking station after visiting another station once during the first intervention phase, twice during the control phase, and four times during the second intervention phase. Participant 2 returned to the truck station after visiting another station twice during the first control phase, four times during the intervention phase, and five times during the second control phase.

Appendix J

Brief Description: Column graph of on-task, off-task and technology

Summary Description: This is a column graph of the percentage of the total time the participant spent on task, off task and using technology. The percentages can be accessed in the following table.

	Participant 1			**Participant 2**		
	Trial 1: Intervention	**Trial 2: Control**	**Trial 3: Intervention**	**Trial 1: Control**	**Trial 2: Intervention**	**Trial 3: Control**
Technology	**32.9%**	**10.5%**	**25.5%**	**23.9%**	**37.1%**	**13.3%**
On Task	**33.7%**	**68.4%**	**54.8%**	**48.3%**	**11.3%**	**27.9%**

Off Task	**33.4%**	**21.1%**	**11.1%**	**27.8%**	**51.5%**	**58.8%**