ABSTRACT

Promoting Generalization of Communication Training by Use of the iPad™

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The current study examined the effects of communication training with an iPad™ used as a speech generating device (SGD) to promote generalization to community settings. The participants were taught to use the iPad™ with the TapToTalk™ application in the training setting to request preferred items that would be accessible in a community setting. Multiple baseline data across participants indicated that the participants not only effectively used the iPad™ as an SGD in the trained setting but also generalized use of the iPad™ to the community setting with untrained community members. Results suggest that the iPad™ with the TapToTalk™ application is an effective SGD for promoting generalization through the use of natural maintaining contingencies. These results also replicate other study's effectiveness of communication training for individuals with limited communication skills.

Promoting Generalization of Communication Training by Use of the iPad™

by

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A Thesis

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And finally, to my husband William Strickland who has been my rock, always believed in and supported me in all my endeavors. Who so lovingly and unselfishly cared for and spent time with our son Cort on the days I needed to focus on my work.

CHAPTER ONE

Introduction

Children with developmental disabilities face multiple deficiencies including a delay in or a complete lack of appropriate communication skills (American Psychiatric Association [APA], 2000). Communication is essential for academic learning as well as learning socialization and independent living skills. Without the means to communicate, children with developmental disabilities tend to exhibit challenging behaviors in order to gain access to or escape from various stimuli. In other words, challenging behavior functions like communication (Carr & Kemp, 1989). For example, when a child with a developmental disability wants his drink that is placed out of reach, he may exhibit challenging behaviors, such as screaming, as a way to communicate that he wants his drink; whereas a typically-developing child his age may state "I want my drink". Both the screaming and the spoken statement serve the same request function (Carr & Kemp, 1989).

There are multiple topographies of challenging behaviors. Common topographies include aggression, elopement, self-injurious behaviors, and property destruction (Durand & Carr, 1991). Such challenging behaviors can be socially offensive, dangerous, an added stress to family and a disruption to peers in the classroom (Carr & Durand, 1985; Durand & Carr, 1991). For instance, instructional demands that are placed on children in classroom settings may function as aversive stimuli for one child. This child then exhibits challenging behaviors in order to escape the demand, thus disrupting the class and educational process (Carr & Durand, 1985).

The same reinforcement contingencies that account for a typically-developing child's desirable behaviors, such as speech, may account for the undesirable behaviors of a child with a developmental disability (Cooper, Heron, & Heward, 2007). For example, a child who cleans his room probably receives praise after doing so, whereas a child who frequently tantrums in the same situation may have received attention in the form of reprimands. Both consequences are forms of attention and have the capability to reinforce the preceding behaviors. Desirable and undesirable behaviors are learned and maintained through interactions with the environment.

Positive and negative reinforcement are the interactions maintaining desirable and undesirable behaviors. Positive reinforcement is when a behavior is followed by a stimulus that will increase the frequency of that behavior in the future. For example, a child is given a gold star for using the toilet. Negative reinforcement occurs when a behavior is followed by the stopping or avoidance of an aversive stimulus that will increase the frequency of that behavior in the future. For example, when a driver gets in the car she will hear a beeping noise until she buckles her seat belt. Buckling the seat belt terminates the aversive stimulus thus reinforcing the buckling behavior and increasing the frequency of buckling behavior in the future.

Reinforcers are categorized as socially mediated reinforcers or automatic reinforcers. Socially mediated reinforcers are contingent upon another person's actions. The three most common forms of socially-mediated reinforcement include gaining access to attention, escaping undesirable activities, and gaining access to tangibles. For example, a child may receive attention in the form of eye contact and reprimands from a parent when he engages in a tantrum. Though this negative or aversive attention; to some

children they see it as attention regardless of the form and thus it reinforces the tantrum. An example of an escape-maintained behavior is a student may get a brief break from his worksheet when he throws a pencil and his teacher makes him sit in the hall for the remainder of class. The student throwing his pencil is his way of escaping the task/demand placed on him. If the teacher then sends the student to the hallway for bad behavior, she is then reinforcing the students escape behavior. Therefore the child is then more likely to throw his pencil in the future to escape a task or demand. Finally, an example of a tangibly-maintained behavior is a child is given a lollipop when he has a tantrum near the candy aisle at the grocery store. Though the child may have stop throwing a tantrum after receiving the lollipop; the lollipop acted as a reinforcer on the child's behavior which makes him more likely to tantrum in the grocery store in the future in order to get a lollipop. Automatic reinforcement consists of behaviors that do not depend on the actions of another person. For example, tapping of one's finger on the table might be reinforced by the stimulation produced from the noise, motion, and vibration.

Identifying the function of challenging behaviors is beneficial in producing a clear understanding of the intervention to be used in reducing those challenging behaviors (Tarbox, Wallace, Tarbox, Landaburu, Williams, 2004). A functional analysis (FA) is the most reliable assessment method to identify the contingencies maintaining a challenging behavior (Hanley, Iwata, & McCord, 2003). An FA is an assessment in which challenging behavior antecedents and consequences representative to that of the person's natural environment are systematically manipulated in a controlled environment for the purpose of identifying the function of the problem behavior. Once the function of the

behavior is identified, it is crucial to teach individuals engaging in challenging behaviors an appropriate and functional alternative behavior that will replace the challenging behaviors. Functional communication training (FCT) is a widely utilized intervention to teach appropriate communication behaviors to replace challenging behaviors (Carr & Durand, 1985).

Functional communication training is an intervention in which individuals are trained to produce an alternative communicative response which serves the same function as the challenging behavior (Carr & Durand, 1985). For example; a child hits his chin each time he wants something to drink. During FCT, the trainer will teach the child an appropriate alternative form of requesting a drink such as a sign, use of a communication device, or saying a request "I want a drink". In addition, extinction can be paired with FCT (Hagopian, Contrucci Kuhn, Long, & Rush 2005).

Often individuals with developmental disabilities lack the ability to verbally communicate and need augmentative and alternative communication (AAC) that will allow them to communicate. The use of an AAC may compensate for (augmentative communication) or substitute (alternative communication) an individual's vocal mode (Bryant & Bryant, 2002). Unaided communication does not involve the use of devices rather the use of hands or arms to communicate. This is typically seen through sign or gestural language. Aided communication is anything that includes an external device (nonelectrical or electrical) to communicate. This can include but is not limited to speech generating devices (SGDs), pictures, and line drawings.

Communication training, including FCT, frequently involves the use of augmentative and alternative communication methods (Winborn-Kemmerer, Ringdahl,

Wacker, & Kitsukawa, 2009). In fact, the selection of the replacement communication behavior is crucial because the success of FCT is dependent upon the individual's ability to successfully request stimuli maintaining problem behavior with the replacement behavior (Duraind, Beroitt, & Weiner, 1993). Speech-generating devices (SGDs) are a popular AAC choice, often utilized in conjunction with communication training (e.g., Durand, 1999; Franco, Lang, O'Reilly, Chan, Sigafoos, & Rispoli, 2009; and Olive, Lang, & Davis, 2007). A few examples of SGD include but are not limited to Tech/Talk™, BIGmack®, iTalk2™, SuperTalker™, and TalkTrac™ .

Speech-generating devices vary widely, with one of the most distinct differences being the form of speech output. Speech-generating devices may utilize digitized speech output (e.g. pre-recorded whole messages) or synthesized speech output (e.g. pre-recorded robotic or device generated speech of multiple and whole messages). Speech-generating devices used are typically bulky, cannot be easily carried from one setting to another, limited in the number of responses that can be programmed and can be stigmatizing (Valiquette, Sutton, & Ska, 2010). For example, the SuperTalker™ is able to hold multiple levels of messages but in order to have access to more than 8 at a time, the icon sheets must be switched out and the switch flipped to the next level. This may be time consuming, difficult to carry multiple icon sheets, as well as confusing.

Generalization is the ultimate criterion of effectiveness of any intervention, particularly communication training. Durand (1999), states that a true intervention strategy is not one that limits its ability to reduce problem behaviors and increase communication efforts to the confounds of the trained setting; but that it also incorporates it into the everyday life and environments. That is, for the communication training to be

considered functional and valuable, the child should be able to extend the use of the replacement communication behavior to untrained settings and in the presence of untrained people.

Two forms of generalization exist, response generalization and stimulus generalization (Cooper et al, 2007). Response generalization is the extent to which an untrained response is produced by the individual that is equivalent to the trained behavior. An example of response generalization would be teaching a child to say "hello" when answering the door and the child generalizes and begins to say "hi". Stimulus generalization is when the individual emits a trained response in the presence of different but similar stimuli (setting, person, and time) as in the trained stimuli (Cooper et al, 2007). An example of stimulus generalization would be teaching a child to say 'hello" when answering the door at home and the child generalizes and begins to say "hello" when opening the door at school. Children with developmental disabilities typically have difficulty generalizing learned behaviors when the initial instruction had not programmed for generalization; therefore, in order to increase their efforts of generalization we must teach not only new behaviors, but also program for generalization (Durand, 1993). Stokes & Baer (1977) identify and describe 9 different techniques in promoting generalization. These techniques include:

- *Train and Hope* involves training an individual in one setting and documenting changes in other settings and/or responses but not actively promoting generalization. For example, training a child to request French fries at home; however, at a restaurant the child is not trained to request but documentation is recording if there is any requesting.

- *Sequential Modification* is similar to that of Train and Hope, however; if no change has occurred in the other settings or responses then procedures are taken to accomplish the desired change. In this situation, the child did not generalize to the restaurant setting, therefore; the trainer begins to use procedures to train the child at the restaurant.

- *Introduce to Natural Maintaining Contingencies* involves transferring the behavioral control from the experimenter to stable and trusting natural contingencies in the individual's environment. For example, when teaching the child to request French fries at a restaurant the trainer will teach the child a behavior that would naturally result in the delivery of French fries. Instead of the trainer teaching the child to clap for French fries, the trainer would teach the child to say "I want French fries" because receiving French fries is the natural consequence for saying "I want French fries", not clapping.

- *Train Sufficient Exemplars* involves training an individual one exemplar of a generalizable lesson and if no generalization has occurred then training of sufficient exemplars is continued until generalization occurs. Back to the example; say that generalization still had not occurred at the restaurant. In this situation, the trainer would then train the child on sufficient (not all) exemplars such as training conducted by different people (e.g., restaurant servers, parents, teachers, etc.) or in different settings (e.g., home, school, day care, various restaurants, etc.).

- *Train Loosely* involves training with little control over the stimuli presented and the appropriate responses, thus allowing generalization of relevant dimensions. In

this situation, the trainer does not emphasize tight restrictions during the training of the child's requesting of French fries which allows for greater range of stimuli and perhaps response generalization.

- *Use Indiscriminable Contingencies* involves promoting generalization by making contingencies for reinforcement and the settings of whether or not reinforcement is delivered indiscriminable. In this situation, the trainer will need to program for reinforcement by making the training settings as similar as possible to the generalization settings. This could be done by using intermittent reinforcement. For example, there will be times that a request for French fries would result in delivery of French fries and times it would not. Just like in real life, there will be times people get what they ask and times they do not get what they want. The trainer needs to use indiscriminable contingencies such as intermittent reinforcement to account for what will happen in real life.

- *Program Common Stimuli* involves ensuring that common and salient stimuli are present in both the trained setting and generalization setting. For example, the trainer who taught the child to request French fries in the trained settings acts as a salient stimuli and supports generalization by being present in the generalization setting (restaurant).

- *Mediate Generalization* results in generalization by developing a response that will be utilized in other problems and contain commonality between the original learning and in the new problem. In this case, the trainer will need to train the child to request French fries as he would in the generalization setting in order to promote generalization.

- *Train to Generalize* involves placing a reinforcement contingency on generalization. In this situation, if the trainer is teaching the child the proper way to request French fries to match that of ordering at a restaurant (instead of saying "more"), the trainer will reinforce the child on his ability to modify or generalize his requesting.

Of these approaches, the most dependable technique as identified by Stokes and Baer (1977), is introduce to natural maintaining contingencies whose goal is to train behaviors that will typically meet maintaining reinforcement after the training.

To date, no research has been conducted with the use of the IPad™ as a SGD utilized during communication intervention. The IPad™ with the TapToTalk™ application will allow for custom design of pictures or choice from a library containing over 2,400 pictures, ability to record own voice and sounds, ability to organize in separate albums, and supports multiple languages (http://www.taptotalk.com).

Several benefits of the use of the IPad™ as an SGD exist. First, the IPad™ is widely known and used by individuals with and without disabilities which makes the use of the IPad™ less stigmatizing. It is also more compact and light weight than typical SGDs thus making it easier to carry from one setting to another.

In addition to these known benefits, an additional potential benefit is that the the IPad™ may promote generalization. Specifically, the use of the IPad™ may promote stimulus generalization through the use of natural maintaining contingencies in several ways. First, the use of the TapToTalk™ application with the IPad™ allows for pre-recorded human voice messages. The use of human voice may result in an increased likelihood that untrained community members in untrained settings may be more likely to

respond to the TapToTalk™-emitted communication attempts than if the pre-recorded

message was played in a synthesized voice. For example, a fast food cashier may be

more likely to respond appropriately to the TapToTalk™ application on the IPad™

request for a large soda in a pre-recorded human voice than if it were a synthesized voice.

If the cashier is more likely to respond, then such natural contingencies will promote

generalization. Second, the use of the IPad™ is commonplace in today's society, which

may also promote appropriate responses from untrained community members in

untrained settings. For example, a fast food cashier may be more likely to respond

appropriately to a request for a large soda made on the TapToTalk™ application on the

IPad™ than a request made on a typical SGD because that cashier has a greater

familiarity with the IPad™ than a device used solely for alternative and augmentative

communication among individuals with disabilities. Again, if the cashier is more likely

to respond appropriately, then such natural contingencies will promote generalization.

Finally, the TapToTalk™ application on the IPad™ may also promote response

generalization. Because the IPad™ utilizes human voice output with the ability to record

messages; this may promote response generalization in that the individuals could begin

verbalizing the correct response from the model presented by the TapToTalk™

application on IPad™.

CHAPTER TWO

Review of Literature

This is a systematic review analysis of intervention studies that evaluated the generalization of communication training utilizing electronic, aided SGD among individuals with developmental disabilities. The purpose of this review is to identify current best practices and goals for future research.

Methods

Each identified study met pre-determined inclusion criteria and was analyzed and summarized in terms of (a) participant characteristics, (b) SGD characteristics, (c) FCT Intervention, (d) generalization and (e) results (i.e., inter-observer agreement, treatment integrity, generalization results, and maintenance results).

Inclusion/Exclusion Criteria

To be included in the review, studies had to meet four inclusion criteria. First, communication intervention was implemented. Second, an electronic aided SGD was implemented. Studies that implemented non-electronic augmentative communication methods, such as Picture Exchange Communication System (PECS) and graphic symbols, as well as studies that implemented non-aided augmentative communication methods, such as sign language and gestures, were not included. Third, generalization of communication behaviors taught via FCT was measured. Finally, studies were also excluded if an experimental design was not implemented.

Search Procedure

In order to identify studies meeting the inclusion/exclusion criteria, systematic electronic database searches were conducted in fifteen electronic databases, including PsycINFO, PsycARTICLES, MEDLINE, and the Education Resources Information Center (ERIC). For a complete list of electronic databases, please contact the author. Date of publication was not restricted, but the search was limited to English language, peer-reviewed journals. Keywords "speech generating device", "voice output communication aid", "augmentative and alternative communication", and "assisted communication" were paired with "functional communication training" and "generalization" in all combinations. Boolean operators and truncation were utilized. The electronic database search resulted in the identification of 23 studies. The abstracts of the resulting 23 articles were reviewed to identify studies meeting the inclusion/exclusion criteria, which resulted in six studies included in the review, denoted by an asterisk in the reference.

The reference citations from these six studies were then reviewed to identify additional articles for inclusion. Any article title that appeared to match the content of this analysis was then reviewed. This review resulted in zero studies that met all inclusion criteria.

The surname of the two authors with the most articles that met inclusion criteria (Durand and Wacker) were then searched in the previously identified electronic databases for additional work. This resulted in the identification of several studies; however, none of which that met all of the inclusion criteria.

Finally, in order to identify recent articles, hand searches covering 2008 to 2010 were then completed for the journals that had published the 6 included articles. These journals were *American Journal on Mental Retardation, Behavior Analysis in Practice, Educational Psychology, Focus on Autism and Other Developmental Disabilities, Journal of Applied Behavior Analysis,* and *Research in Autism Spectrum Disorders.* The hand search did not result in any studies meeting inclusion criteria.

Data Extraction

Each identified article was first assessed for inclusion. Then each study was summarized in terms of the following features (a) participant characteristics, (b) SGD characteristics, (c) FCT intervention, (d) generalization and (e) results (i.e., inter-observer agreement, treatment integrity, generalization results, and maintenance results).. The effects of FCT were summarized by reporting the Percent Non-Overlapping Data (PND) in single-subject designs (Scruggs, Mastropieri, & Castro, 1987). In one case, PND could not be calculated due to the absence of individual session data, thus these outcomes were summarized in the terms used by the author of that study.

Inter-rater Agreement

Inter-rater agreement (IRA) was measured for the coding of data extraction for the studies included in the review. Two additional advanced graduate students independently coded 5 articles (83%). Initial agreement between the first author and additional coders were obtained on 138 of 162 items (85%). Discussion between coders was utilized to resolve disagreements, after discussion on the 24 items of disagreement; agreement was obtained on 100% of items.

Results

A total of six studies were identified for inclusion in this review. Table A.1 summarizes each study including participants, SGD type, SGD characteristics, and generalization results.

Participants

A total of 33 participants were included in this review across the six studies. Twenty-four (72%) of the participants were male and nine (27%) were female. Participants ranged from the age of 1 to 15 years old. Children 9 years of age or younger comprised approximately 93% ($n = 31$). Two participants were between the ages of 10 to 15 years old.

Intellectual disability was the most common diagnosis ($n = 30, \ 90\%$) followed by seizure disorder ($n = 7, 21\%$) and autism ($n = 6, 18\%$). *Figure* B.1 illustrates the number of participants with each diagnosis.

Speech Generating Device Characteristics

The types of SGDs used ranged widely in the evaluation of these 6 studies. The most common form of SGD used within these 6 studies contained only one button (response option) to emit a single response (n = 3, 50%). The other three studies each utilized a device ranging from 4 to 16 buttons. All 6 studies used human voice recording for the vocal response being emitted versus synthesized voice. Half of the studies (n = 3) either did not utilize or did not report utilizing picture icons on the SGD . The remaining three studies utilized SGDs in which photos and/or line drawings of corresponding stimuli were used as the picture icons.

Functional Communication Training Intervention

      Settings. Intervention took place in the individual's home with approximately 81% of the participants ($n = 27$). For example, Wacker, Berg, Harding, Barretto, Rankin, & Ganzer (2005), conducted their study involving 23 participants in each participants home. Six of the participants (18%) received intervention at school in inclusive classrooms. Of these six, five also received additional instruction in the community as well.

      Trainer. The trainers who implemented functional communication training to the participants ranged from parent, teacher, and experimenter. A parent implemented FCT for approximately 81% of the participants (n=27). For example, in Olive, Lang, & Davis (2007) the parent implemented FCT with her child. A teacher served as FCT trainer for approximately 15% of the participants (n=5). An experimenter or researcher implemented FCT for 3% (n=1) of participant training.

      Teaching procedures. Procedures in which the trainers of the present 6 studies used to teach FCT to the participants included time delay (N = 1), most-to-least prompting (N = 1), least-to-most (N = 1), and nonspecific verbal, physical, and gestural prompting technique (N = 1). The last two studies mentioned prompting but were not described.

Results

Inter-rater reliability. In all six studies, reliability measures were conducted and reported above .85 for inter-observer agreement. The highest and lowest ranges report for all 6 studies was 84%-100%.

Treatment fidelity. Four of the six studies measured treatment fidelity; though only three reported their findings which were .88 and higher. The other two studies did not indicate measures for calculating treatment fidelity.

Functional Communication Training. Percent Non-Overlapping Data (PND) was calculated for each participant's FCT results. In one case, PND could not be calculated due to the absence of individual session data (e.g., Wacker, Berg, Harding, Barretto, Rankin, & Ganzer, 2005), thus these outcomes were summarized in the terms used by the author of that study in which they reported challenging behavior to have been reduced by 84% during intervention and by 86%, 90%, and 49% across persons, settings, and tasks respectively.

Percent of Non-Overlapping Data was calculated during intervention for both challenging behaviors and requesting. For challenging behaviors, PND of 85% or higher was calculated in three studies. In the remaining two studies PND was calculated in ranging from 0%-100%; these skewed results could be due to stimulus generalization occurring and causing baseline data points to be on zero (e.g. Olive et al, 2008). For requesting PND, data for calculation was only available for two of the studies. On one study PND was determined to be 97% whereas the second study had ranges of PND from

0%-100%. The low PND rates could be due to skewed data points in baseline suggesting generalization of requesting occurring in latter settings (Olive et al, 2008).

Percent of Non-Overlapping Data was also calculated during generalization conditions for challenging behaviors. Percent of Non-Overlapping Data for challenging behaviors across generalization settings was calculated for two studies in which quantitative data was available. These two studies showed PND of challenging behaviors to be 85% or higher across generalization settings.

Generalization. Generalization was reported for all six studies. Four of the studies reported stimulus generalization only (across settings and/or persons). One study reported both stimulus and response generalization and one study reported response generalization only.

The techniques used to promote generalization were identified and assessed. Of the six studies, only one study systematically implemented a generalization technique (Durand, 1999). While the other five studies did not utilize a specific technique to promote generalization, it was measured.

Discussion

The systematic search produced six studies published between the years 1990 and 2009, each measuring generalization of FCT with use of electronically aided communication. Summaries of these studies revealed that the use of aided communication in FCT may result in generalization.

There is limited research on the generalization of communication skills obtained via FCT. Only 18% of FCT studies conducted between 1968 and 2005 have measured

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generalization of the intervention (Olive, De la Cruz, Davis, & Lang 2006). The need for more research with application of generalization techniques is critical to expand the field.

As a result of the limited studies, future research is needed to address the need of interventions aiding in stimulus generalization of learned skills as well as to keep up with advancing technologies. This need can be addressed through the use of communication devices that can promote generalization to untrained settings. A device that may promote generalization through its popularity, ease of use, and transportability is the IPad™. Unlike most SGDs used, the IPad™ is light weight and compact allowing for it to be easily carried to different settings. In addition, the wide use of the IPad may result in an increased response to communication by the general public. In other words, a lay person without knowledge of electronic, aided communication devices may not respond to an individual's attempt for communication through the use of a typical electronic aided SGD simply because of lack of familiarity of the device and its purpose. However, the wide use of the IPad™ as well as the use of human voice recording versus a computerized, robotic voice may result in improved response to communication attempts; thereby increasing reinforcement for communication efforts. In other words, the IPad™ may naturally utilize one strategy to promote generalization, the use of natural maintaining contingencies.

The participants in the studies reviewed were between the ages of one to fifteen years. Future research should also address FCT with adults to assess for ability to learn new skills, maintenance, and generalization. The analyzed studies were also limited in gender differences. The combined total participants were 33 which 24 of them were male and only nine female. Future research should also address these limitations.

CHAPTER THREE

Methods

As a result of the limited studies that address generalization in communication training, the present study will focused on using a SGD to promote generalization. Specifically, it utilized an IPad™ as the SGD during communication training in order to assess generalization to untrained settings.

Participants

Three children (one male and two female) participated in this study. All three participants are diagnosed with a form of a developmental disability. Mary is a 12 year old female with a diagnosis of mental retardation, seizure disorder with mild seizures, and visual and speech impairment. Her mother reports that she has great receptive language skills with limited expressive language skills and difficulties spontaneously producing sentences of at least three words. Anne is a 15 year old female with a diagnosis of autism with no speech. Her mother reports that she understands receptively but lacks expressive language abilities. Joel is a 10 year old male with a diagnosis of PDD-NOS and seizure disorder with very limited speech. His parents report that he understands well and will often say one word phrases when excited. Informed consent from the parents or guardians was required in order for the children to participate in the present study.

Materials

An IPad™ with the TapToTalk™ application was used to train participants to request items or activities frequently used in the community. The application was individualized with icons representing choices identified through parent interview as valuable to community involvement. When the icon was touched, a pre-recorded spoken message corresponding with the icon was emitted. Anne and Joel were not capable of echoing speech and Mary would not echo the experimenter, therefore, the messages were recorded with the voice of a same-age, same-sex peer. Message output matched to the participants' receptive ability. In other words, Anne was capable of understanding 1-word phrases therefore she had icons programmed to emit a one-word phrase (e.g., "coke"). Mary and Joel were capable of understanding 3-4 word phrases therefore they had icons programmed to emit three-word phrases (e.g., "I want a soda).

Setting

Sessions were conducted either in the participant's home or the Baylor Autism Resource Center (BARC) as well as in the community setting as identified through each participants' parent interview as the preferred community setting. For Mary training took place at the BARC with the community setting McAlister's Deli and the Baylor campus gas station. For Anne training took place at her home with the community setting as Wendy's. For Joel training took place at the BARC with the initial community setting as the Baylor food court but was changed to CVS Pharmacy due to modifying choice items.

Data Collection and Measures

Intervention sessions were five minutes in length due to participants' inability to attend for longer periods of time. A video recorder was used to record every session for each participant, this enabled coding using pencil and paper later in time. The dependent variables, which included independent communication with the TapToTalk™ application on the IPad™ and independent verbal requests, were measured using 10s partial interval recording. See Table A.2 for operational definitions of these behaviors. Data collection was completed by the experimenter and a trained graduate student attending Baylor University.

The graduate student was trained to conduct the data collection procedures prior to the study until she met 90% or higher inter-rater agreement (IRA). First, the graduate student data collector observed video recordings of the participants in order to define and identify examples and non-examples of the operational definition of the participants' target behaviors. Second, the experimenter modeled the data collection procedure and allowed ample practice utilizing video recordings of the participants. Finally, the graduate student independently coded video recordings of the participants until at least 90% agreement was obtained for three consecutive 5-min sessions.

Inter-observer agreement was calculated for 30% of all sessions by the experimenter and a trained graduate student. Inter-rater agreement was calculated by dividing the number of agreements (occurrence and nonoccurrence) by the total number of intervals and then multiplying the quotient by 100% (Cooper et al, 2007).

Treatment fidelity was measure by a trained graduate student. A checklist was utilized to score the following two components: (a) use of progressive time-delay

prompting procedures to teach participants to use the IPad™ and (b) reinforcement of the participant's communicative behavior (Data Sheet D.2). The graduate student made a tally under a column labeled "correct" each time component a or b was implemented correctly. When an error occurred in one of the components, the trained graduate student made a tally under a column labeled "error". Treatment fidelity was calculated by dividing the number of correct items by the total number of items (correct plus error) and then multiplying the quotient by 100%.

Procedure

This study consisted of four phases. First, a parent interview was conducted. Second, a baseline condition was conducted in the child's home or the BARC and community setting. Third, a communication intervention targeting parent-identified requesting behaviors was conducted in the child's home for Anne and in the BARC for Mary and Joel. Finally, generalization probes were conducted in the community settings previously identified by the participants' parents.

Parent Interview

An informal interview with each participant's parent(s) was conducted. The purpose of this interview was to identify community settings in which the participant has the opportunity and/or need to communicate with community members, but currently has no ability to independently do so. For example, Mary's mom identified that her daughter enjoys drinking tea from McAlister's Deli, but does not currently independently place an order with a server or cashier. The identified target requests were utilized in the intervention and generalization phases of this study and the community settings were

utilized in the generalization phase of this study. For Mary, the identified community setting was McAlister's Deli and the Baylor campus gas station. The target requests were sweet tea and M&Ms. For Anne, the identified community setting was Wendy's with her target requests of a coke and French fries. And for Joel, the original community setting was the Baylor food court with target requests of soda and French fries. Upon lack of progression in requesting during intervention, his target request was modified to soda and movie since movie was highly preferred for him and his community setting was changed to CVS Pharmacy, a location the family frequently visited for movie purchases.

Communication Intervention

Baseline. Baseline conditions were conducted simultaneously in both the training setting (i.e., home or BARC) and the untrained setting (i.e., community setting). The participants' typical routines in both settings were maintained throughout baseline conditions. While in each setting, participants have access to the IPad™; however, no training or prompting took place. Furthermore, target communication behaviors were not reinforced by the experimenter in the training setting. Reinforcement would only occur in the community setting if the community-person communication partner present gave it. For example, Anne went to Wendy's and requested French fries from the cashier; reinforcement would be dependent on the cashiers responding to the request. All other behaviors will be responded to as usual. Baseline sessions were not timed, rather; the participant was asked by the experimenter and/or the community person what they would like and after two communication break downs of no responding the session was ended.

This was done to keep from taking up time and backing up lines at the community setting.

     Communication Training. Intervention conditions were 5 minutes in length and took place in the training setting only (i.e., home for Anne and BARC for Mary and 3). Intervention conditions were similar to baseline conditions, except the experimenter implemented a progressive time-delay prompting procedure to teach participants how to utilize the the TapToTalk™ application with the IPad™. First, the experimenter placed the desired item (as identified in the parent interview) in sight, but out of reach from the participant. Second, the experimenter provided a discriminative stimulus (S^D) similar to what would be expected in the community setting. For example, for all participants the target community setting was either a fast food restaurant or store where the participant would need to request a soda, tea, or French fries, during intervention, the experimenter mimicked the behavior of the cashier. Specifically, the experimenter asked each participant, "How may I help you?" or "What would you like today?" Next, the experimenter implemented a progressive time-delay prompting procedure with hand-over-hand prompts to occasion the participant's use of the IPad™. This prompting technique was chosen to allow for transfer of stimulus control from the stimulus that already controls the response to the relevant stimulus (Duker, Didden, & Sigafoos, 2004). Once the participant made three prompted or unprompted correct responses, the time-delay was increased to two seconds, then to four seconds, then to six seconds, and so on. Intervention continued until the participant received 100% independence across three sessions.

Generalization. Generalization sessions in the community settings occurred both during baseline and after intervention had been completed. This allowed for assessment of the effects on training of the use of the IPad™ on communication outside of the training setting (i.e., home or BARC). The generalization condition was identical to the baseline community condition. Participants meet the researcher at their target community settings. The IPads™ were available for use during each community visit; however, there was no training or prompting for use of the IPad™. Reinforcement for the use of the IPad™ only occurred if the communication partner present gave it. For example, Mary went to McAlister's Deli and requested tea from the cashier, reinforcement would be dependent on the cashiers responding to her request.

Experimental Design. A multiple baseline design across participants was used in the present study. Visual analysis was conducted to analyze the results of intervention and generalization probes. All participants and settings began in baseline condition simultaneously. When data in the baseline condition was stable, intervention began for the first participant while baseline continued for the other participants. Once an intervention effect had been observed with the first participant, intervention will then begin with the second participant. This will continue across all participants.

CHAPTER FOUR

Results

The results of the study are displayed in Figure B.2. During baseline for all three participants target responding using the iPad was at zero in both the training and community settings. During baseline each participant would randomly and repeatedly press buttons on the iPad™, perseverating on the buttons for stimulation. Therefore, if the response on the iPad during each session was not the target response as identified in the parent interview then it was not considered a communication response.

During intervention, Mary independently requested a mean of 11.1 requests per session and verbalized two requests during the first session of intervention only (*Figure B.3*). No other verbal target requests were made during the other sessions. Mary had two sessions of 100% responding rather than three. The decision to move her to the next phase was based on data showing that she may have became satiated since she was at 95% and 100% at her first two sessions and quickly dropped. Once her responding was stable, she was moved to the generalization phase. Anne independently requested a mean of 10.6 requests per session and met the 100% across three sessions mastery. Joel had a mean of 2.3 requests per session during the first intervention. Since Joel's independent requesting was low and dropped to zero during session 12, the target items were modified. A new baseline was conducted in the new community setting with the new target responses of movie and soda. The participant had one session of 100% during baseline possibly due to effects of previous intervention. Once baseline was complete,

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Joel was moved back to intervention. After the second intervention began on Joel, independent requesting increased to a mean of 8.6 requests per session.

Implementation of communication training using the iPad™ with the TapToTalk™ application resulted in an increase in target requesting in the generalization setting. As illustrated in Figure B.2, all three participants independently responded to requests with their target response using the iPad™ in the community setting at 100% by the third session. Mary responded immediately to her community communication partner. Anne responded after the first session and Joel responded after two generalization sessions.

Inter-observer agreement was caluculated during baseline in the training and community setting at 100%. The mean IOA during intervention was 97.5 (range = 90% to 100%). Inter-observer agreement during generalization setting was calculated at 100%.

Treatment fidelity was calculated for 52% of all intervention sessions. The mean during intervention was 99.1% (range = 91%-100%).

CHAPTER FIVE

Discussion and Conclusions

This study's findings replicate other studies efforts of communication training

using a speech generating device. This study contributes to the literature in that as of

date, no studies have been published with use of the iPad™ as a SGD in an effort to keep

up with advancing technologies. This study also contributes more data on stimulus and

response generalization.

Each participant successfully increased their responding by use of the iPad™ with

the TapToTalk™ application. A few factors may contribute to the mastery of the use of

the application. First, the images on the screen are very large making it easier for the

participants to see the items as well as the ability to correctly press each item without

accidently hitting another. Second, the item choices were individually selected for each

participant through the parent interview. The two items selected were highly desired

reinforcers. Lastly, reinforcement of the desired item was immediately given upon

request with use of the iPad™. This form of continuous reinforcement is used to correctly

develop participants' responding (Cooper et al. 2007).

All participants in this study not only increased their responding but demonstrated

stimulus generalization across settings and persons with one participant also

demonstrating response generalization. Since the iPad™ is widely known and used, it is

less stigmatizing to be used as a SGD. The iPad's™ light weight and efficient size make

it more portable and able to carry to different settings with ease. These factors may have

contributed to the participants' ability for stimulus generalization. The iPad™ with the TapToTalk™ application allows for own voice recording with human voice output. This feature of the application may have encouraged Mary to verbalize two of her responses. All of these factors may suggests that the iPad™ may utilize natural maintaining contingencies to promote generalization.

Two other factors may have also contributed to the participant's ability to generalize their use of the iPad™. One, since the community members responded to the requests made on the iPad™, their response to the participants reinforced the participant's generalized requests on the iPad™. Two, the fact that the experimenter was present during the training setting as well as in the generalization setting, the use of common stimuli may also attribute to the generalization affects.

The results of this study show to be promising, however; there are limitations that need to be considered. First, two of the participants have been exposed to a communication device such as the SuperTalker with little to limited use mostly at school. Their exposure to a device could explain how they mastered the TapToTalk™ application use so quickly. Second, only two choice items were used thereby making training easier and quicker. Only having two choices can limit the participants to certain environments when using the iPad™. Third, this study did not address challenging behaviors or the function of the behaviors. Lastly, this study was conducted in a limited time frame with limited tools and resources.

This is the only study to my knowledge that has been conducted using the iPad™ as a SGD. Future research is needed to replicate and add to the literature of communication training with use of the iPad™. Focus should be put on reducing

challenging behaviors through functional communication training. As well as using multiple choice responses to expand on the use and function of the iPad™. This could allow the iPad™ to be used at home, school, and other clinical and community environments. Future work in this area should also evaluate the effects of stimulus and response generalization in which the iPad™ may contribute to the use of natural maintaining contingencies. Researching and assessing the effectiveness of these topics shows promise in aiding individuals with communication deficits to better communicate in order to integrate into their community and settings.

APPENDICES

APPENDIX A

Table A.1.

Characteristics of studies reviewed

Study	Participants	SGD Type	SGD Characteristics	Generalization Results
Durand (1999)	four male and one female participant, ages 3-15 years	Introtalker (Prentke Romich)	16 buttons, voice recording	stimulus generalization
Franco et. al (2009)	one 7-year old male participant	Go Talk; DysphagiaPlus LLC, Shreveprot, LA	static display of 12 choices in multiple overlays; photographs of actual stimuli; voice recording	stimulus generalization
Harding, Wacker, Berg, Barretto, & Ringdahl (2005)	one male and one female participant, ages 1-5 years	BIGmack® microswitch	one button; no pictures of stimuli; voice recording	stimulus generalization
Harding, Wacker, Berg, Lee, & Dolezal (2009)	one 2-year old male participant	BIGmack® microswitch	one button; pictures of stimuli; voice recording	stimulus generalization
Olive, Lang, Davis (2007)	one 4-year old female participant	Touch Talk Direct	four buttons; pictures of stimuli; voice recording	response generalization
Wacker, Berg, Harding, Barretto, Rankin, & Ganzer (2005)	seventeen male and six female participants, ages 1-6 years	microswitch	one button; no pictures of stimuli; voice recording	stimulus & response generalization

Table A.2.

Definitions of target behaviors

| Behavior	Definition
Requesting	Depression of the TapToTalk™ application on the iPad™ which results in production of the pre-recorded message or verbalization of the desired item
Time-Delay Prompting	The experimenter using hand-over-hand prompting within a two second progressive time-delay until 100% independence is reached across three sessions
Reinforcement	Participant is provided with requested item following the appropriate request
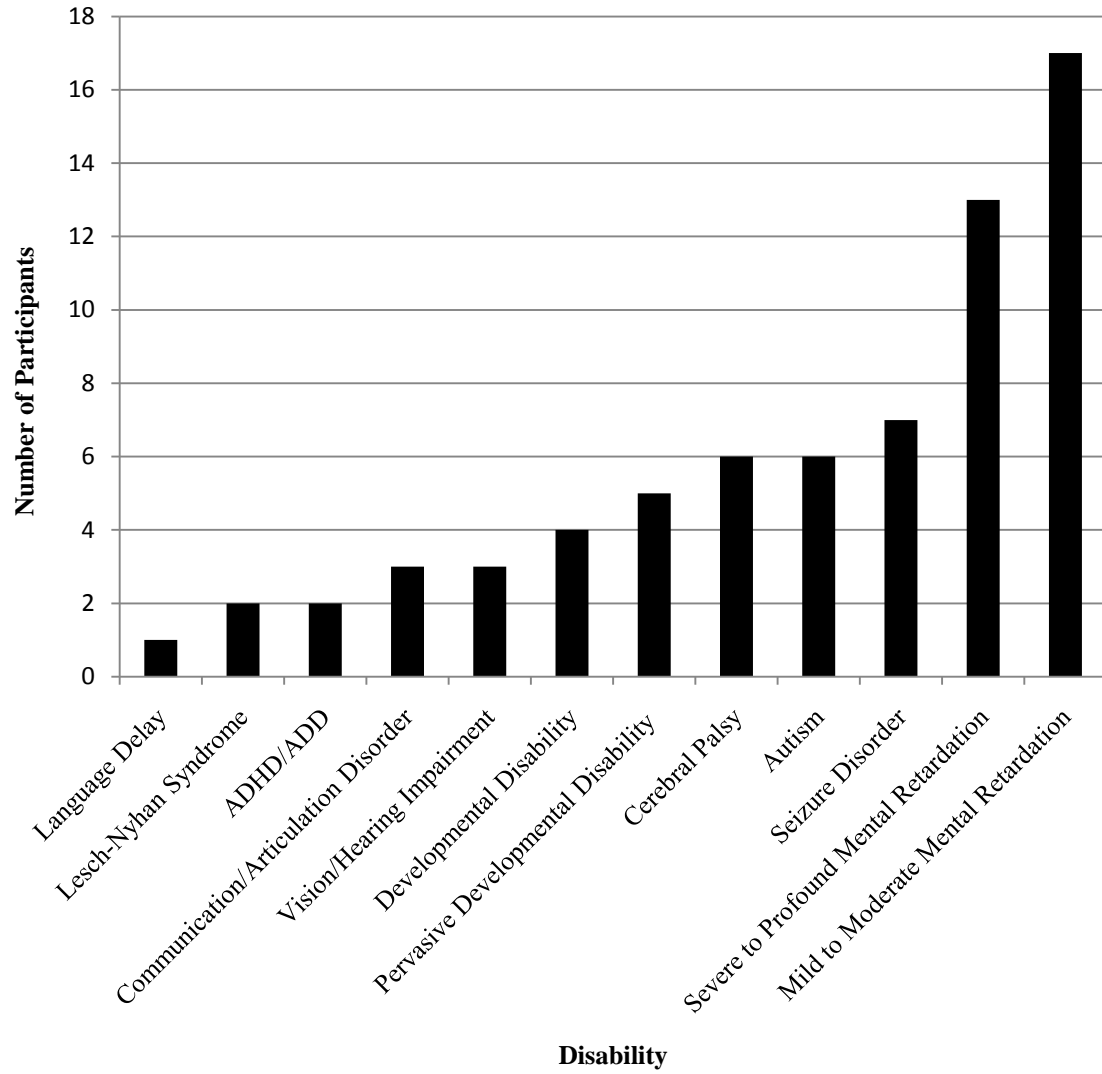
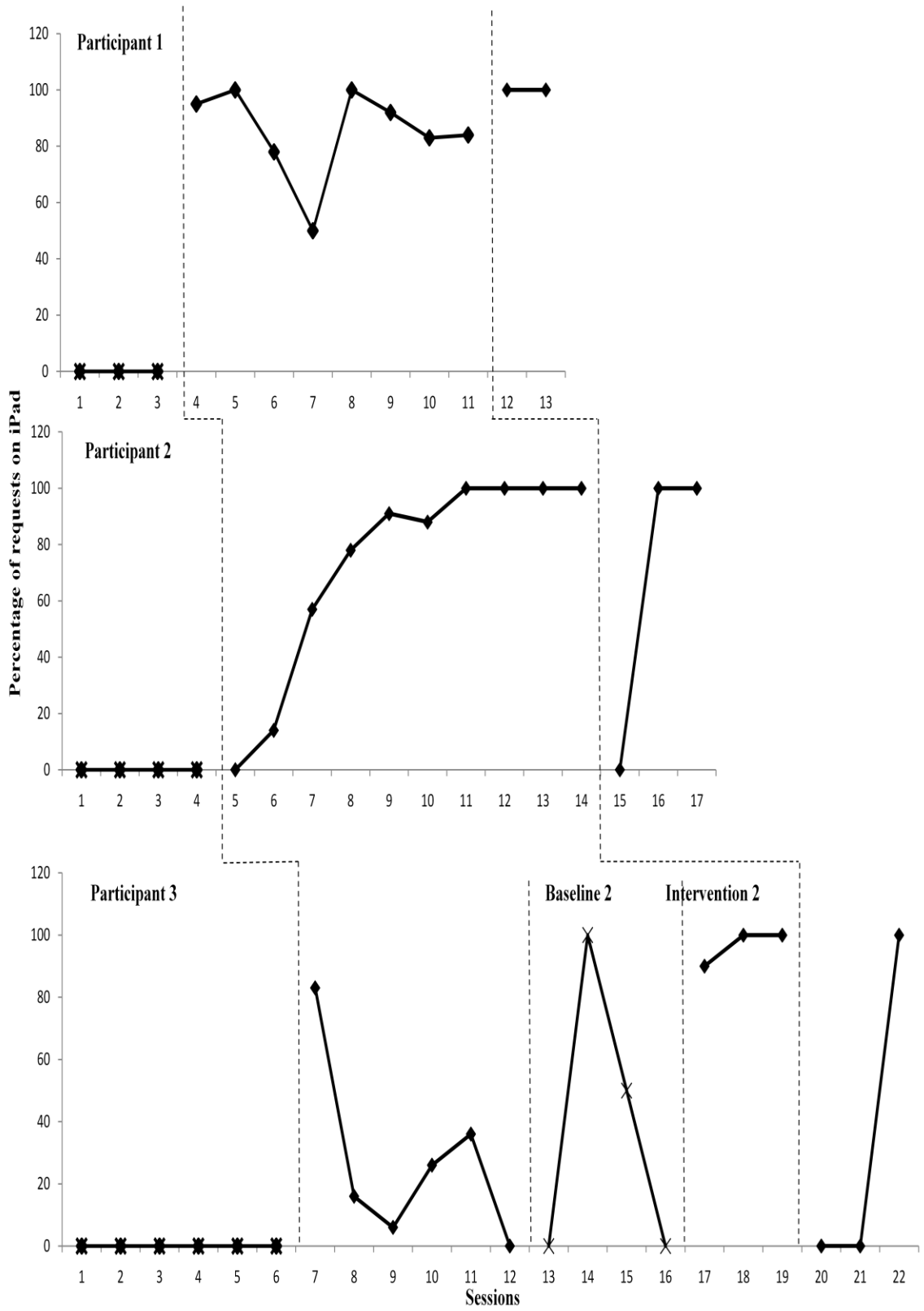*Figure. B.1.* Disabilities identified among participants (n=33)

Figure B.2. Percentage of each participant's requesting on the iPad™ in all settings (x's represent the community setting during baseline).
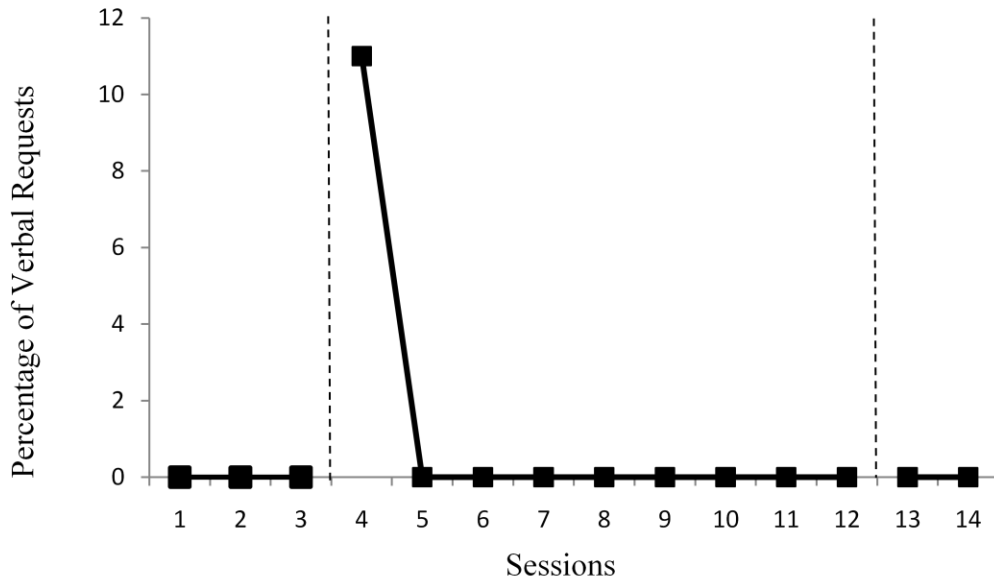
Figure B.3. The percentage of Mary's verbal requests are displayed in baseline, intervention, and generalization.

APPENDIX C

Data Sheet C.1. 10 second partial interval recording

Participant _____ Date _____

Primary Researcher _____ Session _____

Secondary researcher _____ Page ___ of ___ _____

	1	2	3	4	5
10	IPad verbal	IPad verbal	IPad verbal	IPad verbal	IPad verbal
20	IPad verbal	IPad verbal	IPad verbal	IPad verbal	IPad verbal
30	IPad verbal	IPad verbal	IPad verbal	IPad verbal	IPad verbal
40	IPad verbal	IPad verbal	IPad verbal	IPad verbal	IPad verbal
50	IPad verbal	IPad verbal	IPad verbal	IPad verbal	IPad verbal
60	IPad verbal	IPad verbal	IPad verbal	IPad verbal	IPad verbal

Definitions:

IPad - Depression of the TapToTalk™ application on the IPad™ which results in production of

the pre-recorded message.

Verbal - Verbalization of the desired item.

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Data Sheet C.2. Treatment Fidelity checklist

Session _____   Coder _____

	Correct	Error
A) Time delay implementation		
B)Reinforcement		

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