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Teaching a Communication Protocol via Graduated Guidance on the IPad to Assist in Functional Communication Training for Nonverbal Children with ASD

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TEACHING A COMMUNICATION PROTOCOL VIA GRADUATED GUIDANCE ON THE IPAD TO ASSIST IN FUNCTIONAL COMMUNICATION TRAINING FOR NONVERBAL CHILDREN WITH ASD

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Abstract

Non-verbal children with Autism Spectrum Disorders (ASD) often struggle with functional communication, and are often not able to express their wants, needs, emotions, or engage in meaningful conversations (Hudry et al., 2010; Luyster et al., 2008; Weismer et al., 2010). Picture exchange systems as well as AAC devices (e.g., the iPad) have emerged as viable options to teach this population how to communicate effectively (Charlop-Christy et al., 2002; Couper et al., 2014; Dogoe et al., 2010; Ganz et al., 2015; Greenberg et al., 2012; Logan et al., 2017). PECS has been widely established as an evidence-based practice and is often implemented with children with ASD (Charlop-Christy et al., 2002; Couper et al., 2014; Dogoe et al., 2010). Although PECS has a standardized set of steps for implementation, there is no such set of steps for communication applications on the iPad. No established protocol has emerged to ensure that the implementation of Proloquo2Go on the iPad a smooth, streamlined, and successful transition (Lorah et al., 2014; Lorah et al., 2015; Lorah et al., 2018).

This study examined the use of a graduated guidance to implement a communication protocol via a forward chained task analysis to teach children with ASD to effectively utilize Proloquo2Go on the iPad to get their wants and needs met. A design that most closely aligns with changing criterion was implemented across four young children diagnosed with ASD. Parents and RBTs implemented the intervention in the home. Two children demonstrated three changes in criterion, showing a strong functional relation. One progressed through two changes, and one only made one change in criterion. Graduated guidance was effective for all children, yet difficulties with the iPad halted some progression onto new steps. Social validity questionnaires were sent out to all parents and RBT's involved.

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Dedication

This dissertation is dedicated to my family. My husband, Jon Paul, and children, Atlas and Fitzwilliam, have never stopped showing their love. You have endured long nights spent writing and much time away taking classes. Thank you for believing that I could accomplish anything. My parents and siblings have been instrumental to my motivation and success, and I am forever in awe of the support system I was born into.

Table of Contents

List of Tables

Chapter One: Introduction

Autism Spectrum Disorder (ASD) is a neurological disorder characterized by persistent deficits in social and communication abilities across multiple environments, as well as a presence of restricted and repetitive behaviors or interests (American Psychiatric Association, 2013; Parsons et al., 2017). These symptoms include clinically significant impairment in social, occupational, or other areas of functioning, that are not better explained by an intellectual disability or global developmental delay (American Psychiatric Association, 2013). ASD affects approximately one in every 59 children, and does not discriminate across race, ethnicity, or socioeconomic status. However, ASD is four times more common in boys than in girls **(**Center for Disease Control, 2019).

Children with ASD are diagnosed using the criteria set forth in the DSM-V and may be given a level based on the severity of their deficit areas. Level one requires some supports (e.g., a mild disability with few excesses and deficits to overcome), level two requires substantial support (e.g., disability, with fewer deficits and excesses to overcome than level three), and level three requires very substantial support (e.g., a more severe disability with more deficits and excesses to overcome; American Psychiatric Association, 2013). Although these levels are given with a diagnosis, they do not dictate treatment nor funding; however, they may provide an overview for providers as to the skills and deficits a child may present with (American Psychiatric Association, 2013).

Language Development in Children with ASD

Children with ASD struggle with language and communication, which may impact their social interactions (American Psychiatric Association, 2013). Children with ASD typically present greater deficits with receptive language (i.e., understanding what people say) as opposed

to expressive language (i.e., sharing thoughts and information; American Speech-Language Hearing Association, 2019). This deficit in receptive language can impair a student's ability to learn in the school setting, and impair their ability to learn how to communicate effectively (Hudry et al., 2010; Luyster et al., 2008; Weismer et al., 2010). This lack of receptive language may stop children from understanding directions given by teachers and make it difficult to learn in the typical school setting. Language impairments may also predict later speech, meaning that if children with ASD had impairments at age two those same impairments may exist when the child is five (Thurm et al., 2007). These language impairments, both receptive and expressive, may greatly impact a child's ability to succeed in the natural environment, as they are limited to engaging in inappropriate behavior both to get their wants and needs met and engage in social situations. This struggle makes classroom management more difficult and limits a student's ability to communicate.

When it comes to verbal behaviors such as manding (i.e., requesting an item), and tacting (i.e., labeling an item), these behaviors are often underdeveloped in children with ASD (Carnett et al., 2017). This means that children may struggle getting their wants and needs met, as well as struggle labeling within their environment. Giving students a way to get their wants and needs met in an effective manner will make their everyday lives and social interactions easier and more successful.

Gestures

Gestures often develop atypically in children with ASD. Typically developing children will utilize gestures to communicate about abstract thoughts and ideas (Braddock et al., 2016). However, children with ASD may only develop gestures that get their wants and needs met, while some do not develop gestures at all (Braddock et al., 2016). For example, children with

ASD who lack verbal communication may utilize gestures to pull communicative partners toward physical items or objects, and their use of gestures may not expand to abstract scenarios or objects that are not present, thereby limiting a child's communicative ability to what is physically in their environment (Camaioni et al., 1997; Sowden et al., 2008). Although gestures are effective if the item is present, they do not allow the child to request items that are not present (e.g., items in a separate room or location). These gestures also may not look typical or be easily understood by outside persons, as many children with ASD gesture toward themselves instead of gesturing toward others (Smith & Bryson, 1998).

Verbal Behavior

Many children with ASD also lack intraverbal language (i.e., the ability to engage in a conversation) which greatly impairs their ability to have and maintain friendships (Capps et al., 1998). Intraverbal language is difficult to teach, as many beginning communication programs only facilitate manding (i.e., requesting) and tacting (i.e., labeling), and do not give the child an opportunity to truly engage in meaningful conversations. Additionally, children with ASD have challenges in social reciprocity. This challenge is exacerbated when the child with ASD is non-verbal, making social connectedness even more difficult. Not only is this a problem for children with ASD, but also for their families and peers as many alternative speech devices do not encourage conversational speech (Lorah et al., 2015). To remediate the language and communication deficits, Augmentative and Alterative Communication (AAC) systems are commonly implemented with many children with ASD.

Augmentative and Alternative Communication

Many forms of AAC have been used with children with ASD to assist in getting their wants and needs met. AAC used with this population ranges from low-tech pencil and paper for

children to write their wants and needs to high-tech Speech Generating Devices (SGDs) that act as a voice for the child. Some examples most used with students with ASD include the Picture Exchange Communication System (PECS) and Speech Generating Devices (SGDs), such as the iPad. These devices help children with ASD communicate their wants and needs in the most functional way (Ganz et al., 2015; Logan et al., 2017).

Functional Communication Training

To address the challenges that come along with language deficits (e.g., inappropriate behaviors such as aggression, self-injury, excessive self-stimulation), Functional Communication Training (FCT) was developed to teach a functionally equivalent communicative response as an alternative to any inappropriate behaviors (Carr & Durand, 1985). Teaching children a form of communication allows them to get their wants and needs met while refraining from inappropriate behavior that may previously be acting as communication (e.g., crying to get a cookie, hitting to get attention). To start FCT, a formal functional behavior assessment is conducted in order to determine the function of the inappropriate behavior, and a new system (e.g., PECS, SGDs) is then introduced in order to teach functional communication and remediate any inappropriate behaviors. iPads are used often in FCT, to facilitate a more appropriate communicative response and communicative exchange (Walker et al., 2018).

Picture Exchange Communication System

First introduced in 1994 by Bondy and Frost, PECS is a low-tech AAC system that utilizes picture cards to communicate. The child picks a picture from a book filled with pictures of preferred items and exchanges the picture with a communicative partner to make a request. PECS attempts to give easier and more functional alternatives to sign language or sign pointing to facilitate more fluid and generalizable communication. PECS is built around the principles of

Applied Behavior Analysis (ABA) and verbal behavior. Each phase is systematically taught with various prompting strategies, as well as the idea that manding must first be mastered before tacting is introduced. Children with ASD succeed with PECS due to the ease of access and the ability for students to communicate with pictures as their voice. A plethora of research asserts that PECS is an evidence-based practice and shows quick acquisition throughout the six phases (Charlop-Christy et al., 2002; Couper et al., 2014; Dogoe et al., 2010; Greenberg et al., 2012).

PECS is comprised of six phases that begin with the physical exchange and end with commenting in response to questions. These phases mainly focus on manding by encouraging children to request whatever item they need without the presence of a question being asked. When students progress to steps five and six, the focus shifts from manding to tacting. Tacting is where the child is learning to label their environment with statements such as "I see a dog" and "I like that song." Phase six is the closest communication stage to intraverbal language that PECS allows, with the communicator responding with a sentence to a question asked by a communicative partner (Bondy & Frost, 1994).

Although PECS is adequate at facilitating communication for children with ASD, there are also shortcomings (Couper et al., 2014; Lorah et al., 2013). First, PECS takes a plethora of time and resources to set the book up, including binders, Velcro, a laminator, camera, and printed pictures. These steps may not seem too involved, but each time a new picture is needed a live photo must be taken, laminated, Velcro applied, and added into the PECS book (Bondy & Frost, 1994). This takes much time and limits the number of new photos that are placed into the PECS book. Also, the PECS book is a three-ring binder that is filled with pictures held onto Velcro strips. Not only is this cumbersome to carry around, but picture cards often fall out, and it is stigmatizing to the child. The binder is not something other children are seen carrying, and at

times get left at home due to the size and nature of the binder. PECS does not seamlessly transfer to the iPad. When teaching communication on SGDs, there are many nuances and steps missing if strictly following the PECS protocol. An alternative to PECS is SGDs, particularly the iPad.

Speech Generating Devices. Speech Generating Devices are high-tech forms of AAC that may include iPads, GoTalks, the Dynavox, and any other device that uses a battery-operated system to provide a voice output (Lorah et al., 2013). Much research has been conducted for children with ASD and the Apple iPad (Gevarter et al., 2013; Gevarter et al., 2014; Logan et al., 2017; Lorah et al., 2014; Lorah et al., 2015; Lorah, 2018; Thiemann-Bourque et al., 2017; Van der Meer et al., 2013; Xin & Leonard, 2015). This device is readily available, and many applications have emerged that facilitate functional communication via the iPad. The most frequently used application on the iPad is Proloquo2Go (Xin & Leonard, 2015). Proloquo2Go has emerged as an effective application for children with ASD, with the ability to utilize the camera in the iPad to take live pictures, utilize word tiles, sentence strips, or typing. This suits children at different levels and allows their language abilities to grow as the application advances. However, the application is expensive, costing $250, serving as a barrier for many children and families (Assistiveware, 2019). The research focus when implementing the iPad is typically around manding and tacting, and focusing on what responses the children are giving, rather than the steps to implement the communication training (Lorah et al., 2013, Lorah et al., 2015). Standardized steps are not present when it comes to introducing Proloquo2Go with this population.

Not only can children with ASD mand and tact via the iPad and Proloquo2Go, but they can eventually engage in generative intraverbal language (Lorah et al., 2015). The iPad has the capability to allow for generative typing, which takes away the need for preprogrammed pictures

or printed out cards to be used. Although children may not get to the generative typing level for some time, the ability remains within the SGD and not within the PECS program.

Along with the many abilities the SGD affords, children also prefer the device to the PECS system or other AAC systems (Clark et al., 2015; Ganz et al., 2015; Hill & Flores, 2014; Lee et al., 2015). Children succeed on both AAC systems, yet most of the time they choose the iPad over PECS. This may be due to a previous learning history with the iPad as a reinforcer, or due to ease of access. Either way, the iPad is a more preferred medium, which could translate to more use of the device if paired with early communication interventions. The iPad also contributes to on-task behaviors, which in turn reduces challenging behaviors (Lee et al., 2015). Parents and professionals also prefer to use the iPad, which increases their fluency with the system (Clark et al., 2014).

Statement of the Problem

Although much research has focused on functional communication training for children with ASD, research has not yet focused on how interventionists are implementing training protocols via SGDs, nor on creating specific protocols for those SGD's. The Picture Exchange Communication System has a task analyzed list of steps to ensure that it is implemented with fidelity each time. When utilizing the iPad and implementing communication training, there is no standardized set of steps to effectively teach children how to navigate the iPad or the application the children will use. Therefore, the purpose of this study was to implement a forward chained task analysis via graduated guidance, to provide a clear and concise way to implement communication training through the Proloquo2Go application on the iPad. The research questions addressed in this study were:

1. Is graduated guidance effective in teaching a forward chained task analysis on the iPad, and effective at increasing communicative attempts in children with ASD?
2. Does student implementation of the steps of the task analysis used in this study result in more frequent use of the iPad when compared to gesturing to communicate wants and needs?
3. Do the parents and RBT's think that the iPad-based graduated guidance intervention is effective at increasing communicative exchanges in students with ASD?

Significance of the Study

Children with ASD gesture frequently to get their wants and needs met, yet these gestures may not always be understood as a form of communication (Braddock et al., 2016; Camaioni et al., 1997). These gestures may not be understood by many, nor are they always functional to get the child's wants and needs met. PECS is often introduced to reduce said gestures; however, PECS is time consuming to both introduce and maintain, and also does not leave room for true intraverbal language. Communicating with an iPad is a much more functional way to access outside peers and to communicate wants and needs in a way that can be understood by many rather than only those familiar to the child.

The iPad has not only been shown to be an effective medium for functional communication training but is also a preferred method of communication for children with ASD (Clark et al., 2014; Ganz et al., 2015; Gevarter et al., 2013; Hill & Flores, 2014; Lee et al., 2015; Logan et al., 2017; Lorah et al., 2014; Lorah et al., 2015; Lorah, 2018; Thiemann-Bourque et al., 2017; Van der Meer et al., 2013; Xin & Leonard, 2015). Developing a protocol not only makes it easier for the students to access the electronic device and find the application used, but it also gives teachers and parents a streamlined way to introduce functional communication training via

the iPad. This may increase the time spent using the iPad, as teachers may now feel that they are competent in delivering instruction on the iPad and no longer must guess at how to implement communication training.

All young children are just beginning to learn language and communication, which means that intervening with a functional communication protocol as young as possible will give those students the best chance at learning an effective and socially appropriate form of communication (Lindgren et al., 2020). Young children with ASD also have a shorter history of reinforcement with the iPad as anything other than a communication device, making the possibility of using it as a viable communication device when introduced early (Cooper et al., 1987; Lorah, 2018). This study will look at two-to-five-year-olds in order to address the need for early intervention when implementing communication training.

Definition of Terms

Apple iPad. A handheld mobile computer that allows touch screen use, pencil drawing use, picture taking, Bluetooth keyboard use, internet accessibility, and multiple assistive features (Apple, 2019).

Augmentative and alternative communication. Aided (e.g., things that require external tools) or unaided (e.g. things that do not require an external tool) systems used to enhance communication (American Speech-Language-Hearing-Association, 2019).

Autism spectrum disorder. A complex neurological disorder that may cause problems in feeling, language, thinking, and relating to others. ASD is diagnosed in children and is diagnosed on a spectrum (APA, 2013).

Continuous schedules of reinforcement. Providing reinforcement for every occurrence of behavior (Cooper et al., 1987).

Forward chaining. Prompting the first step in the task analysis until competency is shown, then moving on to teach all the following steps in the same manner (Cooper et al., 1987).

Free operant assessments. A preference assessment in which the student has free access to various potential reinforcers in order to determine a hierarchy of preference (Ortiz & Carr, 2000).

Functional Communication Training. A communication-based approach to address challenging behavior (Walker et al., 2018).

Gestures. A complex movement which can be divided into phase: preparation or the positioning of the hand or arm, an optional pause, the performance of the gesture, another optional pause, and finally retraction o the arm or hand (Sowden et al., 2008. P. 804).

High-p procedures. A series of easy-to-follow requests in order to build compliance, that are then followed by a low probability request (Cooper et al., 1987).

Intraverbal. Verbal behavior under the control of other verbal behavior. In other words, conversational skills (Skinner, 1957).

Mand. Verbal behavior under function control of station or deprivation followed by reinforcement that is often specific by the response. In other words, requesting an item that provides reinforcement (Skinner, 1957).

Multiple stimulus without replacement. A preference assessment in which two items are presented and the child is given a choice between the two. Each item is then removed after the child has access to the item, and not replaced before assessing with two new items (Ortiz & Carr, 2000).

Negative Reinforcement. The removal of a stimulus that increases the likelihood of a behavior occurring again in the future (Cooper et al., 1987).

Positive reinforcement. The presentation of a stimulus that increases the likelihood of a behavior occurring again in the future (Cooper et al., 1987).

Preference assessment. An assessment done with stimuli present in order to determine the preference and order of preference for items (Cooper et al., 1987).

Proloquo2Go. An AAC system designed to give a voice to those do not have one. A customizable application to be used on the iPad that can be programmed for each child depending on their level (AssistiveWare, 2019).

Receptive Language. The process of receiving and understanding a message (National Center on Deaf-Blindness, 2010).

Reinforcers. A stimulus or stimulus change that is used to increase the future probability of a behavior occurring. This will vary from child to child and be an object the child prefers (Cooper et al., 1987).

Speech Generating Devices. Voice output communication devices such as iPads, tablets, computers, and other electronic devices (Lorah et al., 2013).

Tact. Verbal behavior that is under functional control of a non-verbal stimulus. In other words, labeling an item or object (Skinner, 1957).

Task analysis. The process of breaking down a complex or difficult task into a series of behaviors into more manageable and teachable units (Cooper et al., 1987).

Delimitations

As in all studies, there were several delimitations to the design of this study. First, all participants were selected from a large urban city and from a private ABA clinic. This makes sampling convenient and not truly random. However, all participants received the same intervention in the same time frame regardless of age or ability and were chosen based on

eligibility criteria by a BCBA. Also, the task analysis utilized in this study is researcher-created and has not been validated. A single case research design (SCRD), namely a design most closely aligned with a changing criterion design, will be used throughout this study (Horner et al., 2005). The limited number of participants involved may make results difficult to generalize to the rest of the population. However, single case research was the most applicable to find students that met a particular criterion, and due to the varying symptomology of ASD. Due to restrictions surrounding COVID-19, all training took place online, with no face-to-face contact. All interobserver data were taken from videos that were recorded by the RBTs involved.

Conclusion

To assist with the implementation of functional communication training via the iPad, a protocol must be developed and implemented. This will increase the reliability and fidelity of the use of the iPad and encourage teachers and parents to utilize the iPad more (Lorah et al., 2018). The iPad is not only socially accepted, but also allows for the progression of language (i.e., mand to tact to intraverbal) all within one device and within one application. This creates a streamlined process for implementing the iPad for children with ASD that have language delays. Clinicians will also learn how to use the protocol and can implement this with their students on a more frequent basis.

Chapter Two: Literature Review

Children with Autism Spectrum Disorder (ASD) often present with delayed language and struggle to get their wants and needs met in a sufficient manner (American Psychological Association, 2013). Due to this lack of verbal language, this population often engages in gestures, which are only efficient for items that are visible in the immediate environment. In order to provide children with ASD with a more effective form of communication, much research focuses on the use of PECS and SGDs to implement functional communication training (Charlop-Christy et al., 2002; Dogoe et al., 2010; Greenberg et al., 2012; Howlin, et al., 2007; Gevarter et al., 2013; Gevarter et al., 2014; Logan et al., 2017; Lorah et al., 2014; Lorah, Parnell et al., 2015; Lorah, 2018; Ostryn et al., 2008; Thiemann-Bourque et al., 2017; Van der Meer et al., 2013; Xin & Leonard, 2015). Research indicates that both mediums have evidence to support their use for children with ASD to learn a functional form of communication.

Literature Review Procedures

A search of several online databases was conducted; these databases included Academic Search Premier, PsychInfo, ERIC, Child and Adolescent Studies, and Education Full Text. The following terms were used to search through the online database: 1) "communication" and "autism" 2) "communication" and "asd", 3) "gestures" and "ASD", 4) "aac" and "ASD" ,5) "ipad" and "ASD", 6) "language development" and "ASD", 7) "PECS" and "ASD", 8) "changing criterion" and "ASD", and 9) "forward chaining" and "ASD."

Selection Criteria. Articles were included if: (a) they contained children with ASD, and also included PECS interventions, communications administered via the iPad, (b) discussed gesture and language development of children with ASD, or (c) changing criterion research designs and forward chaining. Articles were only included if they were from a peer reviewed

journal and based in quantitative research methods. If the articles did not include the abovementioned criteria, they were not included in the following review.

Language Development

Language development in children with ASD often takes an atypical trajectory (Tager-Flusberg & Anderson, 1991). Along with deficits in communication skills in general, children with ASD also struggle with receptive language, pragmatic skills, theory of mind, discourse ability, and comprehension (Capps et al., 1998; Hudry et al., 2010; Luyster et al., 2008; Tager-Flusberg & Anderson, 1991; Weismer, Lord & Esler, 2010). Children with ASD most often show delayed receptive language when compared with expressive language and exhibit an increase of problem behavior due to their language deficits (Bopp et al., 2009). This delay in language development creates difficulties getting their wants and needs met, maintaining friendships, and engaging appropriately in social activities (Capps et al., 1998; Toth, Munson, Meltzoff & Dawson, 2006). Language delays at a young age can also be a strong predictor of a later diagnosis of ASD and begin impacting children as young as six months of age (Mitchell et al., 2006). See Table 1 for all articles regarding language development.

Table 1

All articles regarding language development

Authors	Diagnoses	Number of Subjects	Age of Subjects	Research Design	Intervention/ Measures	Outcomes
Tager-Flusberg & Anderson (1991)	Autism and Down Syndrome	12	3-7 years old	Longitudinal	Coding of language samples over 1 year	Children with ASD show few advances in language as they age, creating a significant difference in language across time
Hudry et al., (2010)	Autism	152	24-59 months old	Follow up measures from RCT	VABs, PLS, MCDI	Impaired comprehension and production of language, greater receptive delay than expressive

Weismer et al. (2010)	Developmental Delay, Autism, and PDD-NOS	326	~30.9 moths	Follow up measures from RCT	Mullen Scales of Early Learning, VABS-II, SICD	Delays in comprehension and production, children with ASD had higher expressive scores over receptive
Luyster et al. (2008)	Autism	164	18-33 months	Direct assessment, parent interview, parent questionnaire	Mullen Scales of Early Learning, VABS, MCDI, ESCS, IB	Parent interviews matched live assessments, Mullen reported higher rec language, VABS higher exp language, joint attn not a language predictor
Thurm et al. (2007)	Autism, PDD-NOS, DD	131	2-3 years old	Longitudinal	ADI-R, PL-ADOS, SICD, VABS, Mullen Scales of Early Learning	VABS at age 2 was a predictor of later language development, responding to joint attention might predict later language development
Toth et al. (2006)	Autism and PDD-NOS	60	34-52 months	Longitudinal	Early Social Communication Scales, Mullen Scales of Early Learning, VABS	Joint attention and immediate imitation abilities most strongly associated with language skills, those with better toy play and imitation at age 4 acquired comm skills faster
Mitchell et al. (2006)	Siblings of children with ASD	97	11-15 months; 17-21 months	Longitudinal	CDI, PLS-3, Mullen Scales of Early Learning	Subjects understood significantly fewer phrases, and produced fewer early and late gestures

Receptive Language Development

Unlike many typically developing children, receptive language delays have been more frequently found than similar delays in expressive language for many children with ASD. Hudry et al. (2010) examined 152 preschool children with ASD, in order to investigate the patterns of both receptive and expressive language. They found a greater impairment in receptive language as compared to expressive language development. They used multiple measures to assess this receptive deficit and determined that this deficit in receptive language was the related to the inherent nature of the disorder and therefore, difficult to assess with an instrument. This delay in receptive skills may impact understanding directions in the classroom, including questions asking what children want and need, and therefore making it harder for children to truly express their desires (Hudry et al., 2010).

Weismer et al. (2010) also studied language skills in toddlers with ASD, but instead compared those with an ASD diagnosis to those diagnosed with Pervasive Development Disorder-Not Otherwise Specified (PDD-NOS). Their results were similar to Hudry et al. (2010), in that children with ASD had delayed receptive skills in comparison to expressive skills. However, they found that children with PDD-NOS had higher expressive skills when compared to receptive skills. Now that the DSM-V does not discriminate these diagnoses, it may prove difficult to determine the language skills that must be addressed first in order to teach functional communication to individuals with ASD. Weismer et al. also found that children with ASD have significant delays in vocabulary and grammatical abilities related to their age and cognitive ability. This vocabulary and grammatical delay can also cause difficulties in utilizing Speech Generating Devices (SGD) or Alternative and Augmentative Communication (AAC) devices if not starting with simple icons and pictures and moving on to words and spelling.

Luyster et al. (2008) examined receptive and expressive language scores in toddlers as a predictor for future receptive and expressive language ability. They found that parent interviews matched closely with in-person assessments in that both receptive and expressive language were correlated with social cognitive variables as well as motor skills. In terms of predicting receptive language delays, they found that concurrent gesture use and nonverbal cognitive ability predicted receptive language skills the most effectively. Responses to joint attention were also a significant predictor of receptive language, however initiating joint attention was not. This may show that children who do not initiate joint attention with caregivers and peers may still develop receptive language **(**Luyster et al., 2008).

Receptive language delays may impact how children with ASD understand questions being asked and also may predict future language delays. Young children with ASD that present

with receptive language delays may benefit from early communication training, as they may be at more at risk for a language delay. Starting with simple icons or pictures may be beneficial to this population, as children with ASD also present delays with vocabulary and grammar (Hudry et al., 2010; Luyster et al., 2008; Weismer et al., 2010).

Language Predictors

When exploring the development of language and where there may be deficit areas for children with ASD, researchers have often examined certain traits and characteristics as predictors for language delays. Thurm et al. (2007) investigated young children referred for testing for an ASD diagnosis. The researchers found that administering the Vineland Adaptive Behavior Scales Second Edition (VABS-II) between ages two and three was a strong predictor of language at age five, showing that language interventions can be implemented early with children in order to increase their communicative competence. They also found a link between oral, motor ability, and expressive language, potentially due to the fact that many children who have neurological deficits cannot engage in oral and motor activities, and therefore expressive language is not tested.

Toth et al. (2006) also examined the predictors of language in children with ASD and found that joint attention, imitation, and toy play are all accurate predictors of language delays. Children with ASD that demonstrated stronger toy play and imitation at the age of four acquired communication skills at a higher rate, leading the researchers to believe that toy play and imitation were the best predictors of language development, or a lack thereof.

On the other side of play and imitation, Bopp et al. (2009) collected data from 69 children with ASD and examined scores of problem behavior and the onset of problem behavior as a predictor for language skills. The researchers found that ASD severity scores prior to the onset of

intervention were predictive of language production. This may be due to the lack of communication leading to more inappropriate behavior in order to get the students' wants and needs met. Nonverbal IQ prior to intervention was also found to predict changes in receptive and expressive language development.

Mitchell et al. (2006) also considered predictors of language development and examined the communication and language development in children who were at risk for a diagnosis of ASD. They examined 97 siblings of children with ASD and found that they understood significantly less phrases at 12 months than their typical counterpoints and did not respond appropriately to parent-initiated routines or social bids. This can lead to earlier implementation of SGDs and AACs for students that are struggling to communicate at the age of 12 months, without waiting to see if language will develop. The earlier children get a communication system, the more successful they are, and the fewer inappropriate behaviors will be seen.

With the pervasive deficits in language development, come deficits in communication for many children with ASD. This may manifest in more inappropriate behavior and make it difficult for children with ASD to get their wants and needs met. Many children with ASD may rely on simple gestures to get their wants and needs met instead of verbal forms of communication (Bopp et al., 2009; Mitchell et al., 2006; Toth et al., 2006; Thurm et al., 2007).

Gestures and ASD

Children with ASD develop the use of many gestures (excepting protodeclarative gestures) at a similar rate as typically developing children, however the use of these gestures is different within the two populations (Sowden et al., 2008). Children with ASD typically use common gestures (e.g., pointing) to access attention or gets their wants and needs met, and rarely to expand on conversations or reference items that are not present (Sowden et al. 2008). Children

with ASD also struggle with imitation of novel gestures, and often perform the gesture toward themselves and not toward the person they are communicating with (Smith & Bryson, 1998). Smith and Bryson also found that the lack of imitation skills toward gestures was not related to poor receptive or expressive language, nor was it related to memory deficits. It may strictly be an imitation deficit. See table 2 for all articles pertaining to gestures.

Table 2

All articles regarding gestures

Authors	Diagnoses	Number of Subjects	Age of Subjects	Research Design	Intervention/ Measures	Outcomes
Sowden et al. (2008)	Autism	2	2 years old	Case Study	Non-directed play, directed tasks, and PECS training	Gestures typically used to request items, communicative impairments impact both speech and gesture use
Camaioni et al. (1997)	Autism	3	2-4 years old	Longitudinal	Experimental conditions to elicit imperative/declarative pointing	Imperative gestures emerged early and were used often, while declarative emerged late or never emerged
Carmo et al. (2013)	PDD-NOS	26	~7 years old	Experimental	Imitation task to see gesture use	Children with ASD struggled to imitate novel gestures
Braddock et al. (2016)	Autism	35	11-16 years old	Descriptive	SRS, CCC, Cartoon Retell Task	Gestures negatively related to speech and syntax, those with less speech may use gestures to over compensate

Gestures for Requesting

Camaioni et al. (1997) investigated the use of protoimperative (e.g., instructional) and protodeclaritive (e.g., story telling) pointing gestures in three young children with ASD. Protoimperative gestures emerged early and easily for all children. However, protodeclarative

gestures emerged much later and only in two of the three children. Gestures were mainly used to request readily available items that the child could see in front of them.

Along those same lines, Carmo et al. (2013) studied 13 children with ASD and 13 typically developing children in order to determine how high-functioning children imitate actions and gestures. All children with ASD were again impaired in imitating novel actions and gestures, yet all children with ASD could imitate known gestures that did not involve objects. This lack of imitation for individuals with autism makes it difficult to teach functional gesture use across various environments.

Braddock et al. (2016) explored 35 adolescents with ASD in order to assess spontaneous gesture use in children with ASD. They completed social responsiveness scales and communication ability scales and found that gesture rate and communication ability/ASD severity were not correlated. However, gestures were negatively related to speech and syntax, meaning that adolescents with lower speech ability used a higher number of gestures. When conveying information about absent objects or referents, children with delayed speech or syntax utilized more gestures than those that could communicate fluently.

Children with ASD seem to develop gestures at a typical rate yet use gestures mainly for requesting about objects present in the room. This limits their ability to get their wants and needs met, as they cannot convey emotions, feelings, or request items that are out of their point-of-view (Braddock et al., 2016). Although an effective mode of communication to get immediate items requested, if this mode of communication can be replaced by a system that allows for higher level conversational skills and thoughts to be produced, it is paramount to teach a new and more effective system (Braddock et al., 2016; Camaoini et al., 1997; Carmo et al., 2013; Sowden et al., 2008).

Picture Exchange Communication System

In order to meet the needs of students that are non-verbal, the Picture Exchange Communication System (PECS) is often implemented as the first step to encourage communication. First developed and described by Bondy and Frost (1994), the system includes six steps that range from teaching the physical exchange to commenting in the natural environment. Sulzer-Azaroff et al. (2009) conducted a literature review of 34 peer reviewed published articles and found overwhelming evidence that PECS is effective at teaching communication skills to children with ASD and is helping children successfully get their wants and needs met. See table 3 for all articles regarding PECS.

Table 3

All articles regarding PECS

Authors	Diagnoses	Number of Subjects	Age of Subjects	Research Design	Intervention/ Measures	Outcomes
Ostryn et al. (2008)	Autism	1-41	Under 18	Review	PECS	PECS is effective, but subjects may prefer multimodal communication
Greenberg et al. (2012)	Autism	4	4-8 years old	Multiple baseline across participants	PECS	After PECS was taught it generalized to people and settings quickly
Dogoe et al. (2010)	Autism	3	3-5 years old	Multiple baseline across participants	PECS	All participants mastered through PECS phase IIIB with high acquisition rates
Charlop-Christy et al. (2002)	Autism	3	3-12 years old	Multiple baseline across participants	PECS	All participants mastered PECS quickly, speech increased, a decrease in problem behavior was noted
Howlin et al. (2007)	Autism	84	~73-85 months	RCT	PECS	Participants taught by teachers expertly trained in PECS that provided immediate intervention had significant post treatment outcomes
Lerna et al. (2014)		14	18-60 months	Long term follow up	ADOS, GMDS, VABS, free play with examiner	PECS group showed improvements over conventional language therapy, lower ADOS

						severity scores, higher GMDS and VABS scores
Ganz & Simpson (2004)	Autism	3	3-7 years old	Changing Criterion	PECS	All participants made progress in mastering PECS, spoken words increased. And skills were generalized to multiple people
Ganz et al. (2015)	Autism	1	4 years old	Multiple baseline across Target Words	PECS App	Only a slight increase in receptive language after teaching on PECS app

PECS Effectiveness

Much research has focused on asserting PECS as an important and effective AAC system for children with ASD (Charlop-Christy et al., 2002; Dogoe et al., 2010; Greenberg et al., 2012; Howlin et al., 2007; Ostryn et al., 2008). Through both the research and systematic reviews that have been conducted, PECS has emerged as an evidence-based practice. Ostryn et al. (2008) completed a review of PECS research previously conducted. Through the communication competence paradigm (e.g., generalization, spontaneous communication, joint attention, and maintenance) they evaluated whether PECS met all facets of the paradigm.

The researchers found that the most effective communication system for children with ASD may in fact be multimodal (i.e.., PECS along with manual sign) and that the child's conversational abilities need to be taken into consideration when developing a communication system. They also concluded that more focus needs to be on generalization, the operational definition of spontaneous communication, how joint attention is measured, and the maintenance schedules used to maintain all skills taught (Ostryn et al., 2008). Due to the nature of PECS (e.g., only utilizing words and pictures that have been printed and laminated and are available), true spontaneous communication is difficult to achieve within the system which may contribute to the lack of operational definition of spontaneous communication.

In order to add to the research on generalization, Greenberg et al. (2012) focused on determining more extensive assessments of generalization and a more streamlined way to train for assessing generalization of PECS. Four boys with ASD were introduced to PECS, which was then generalized across settings and people. All boys acquired through phase four (i.e., using phrases) and acquisition of all phases was quick. The skills taught and learned were easily generalized to various settings and people, and the generalization was easily assessed through probes. However, the researchers did not assess generalization of spontaneous communication or through phase six of PECS.

Dogoe et al. (2010) also examined the effects of PECS on requesting skills and how well they generalize across people, settings, and stimulus classes. Three young children with ASD were involved in the study, and all three acquired PECS through phase three (i.e., picture discrimination). They found that problem behaviors were reduced, yet these behaviors delayed acquisition of the phases. All acquired skills generalized easily to people and settings, however, generalizing across stimulus classes was more difficult. This presents a problem, since children must be able to get their wants and needs met when presented with any stimuli that is available.

Much of the research of PECS focuses on the "quick" acquisition rate of all skills. Charlop-Christy et al. (2002) examined the amount of training needed in order to master PECS across three boys with ASD. All three children mastered the PECS protocol within an average of 170 minutes total, which is only 2.8 hours to master the entire system. This research asserted that not only is PECS effective at teaching communication skills, but it can be taught relatively quickly and give children access to volitional communication.

Along with the acquisition and generalization rates of PECS, it is important to determine whether teacher training and teacher implementation affect the acquisition of PECS. Howlin et

al. (2007) conducted a randomized controlled trial designed to determine whether expert guidance of teachers in the use of PECS would lead to an increase in spontaneous PECS use, spontaneous communication, and speech for children with ASD. The children receiving immediate treatment provided by a teacher that was expertly trained as well as those that received training from a teacher two terms following their expert training had a significant post-treatment increase in the rate of their initiation as well as their use of PECS was noted. The researchers did not find that an increase in speech was noted as a difference between the two groups.

Not only does PECS have a high acquisition rate and is effective in the moment, but it continues to be effective after treatment has ended, as well as has an impact on social communication skills. Lerna et al. (2014) conducted a follow up study with 14 children from a previous study that were all diagnosed with ASD. Standardized assessments were given 12 months post training, and ADOS scores were lower on communication domains, higher scores on the VABS domains were achieved, and cooperative play improved in the PECS group as well. Free play was observed, and participants had higher joint attention and initiation during this play time.

Teachers and clinicians must be adequately trained in how to generalize PECS and take data on that generalization, and they must also be properly trained in the implementation of PECS. Without true understanding of the system and how it works, students cannot acquire the necessary skills quickly (Charlop-Christy et al., 2002; Greenberg et al., 2012; Howlin et al., 2007; Ostryn et al., 2008). PECS has much research behind it to support implementing with children with ASD, is acquired quickly, and is often times generalized easily (Charlop-Chrisy et

al., 2002; Dogoe et al., 2010; Greenberg et al., 2012; Howlin et al., 2007; Lerna et al., 2014; Ostryn et al., 2008).

PECS and Language

Many providers and parents are hesitant to implement PECS due to a fear that it may discourage vocal speech. Research suggests the opposite. Ganz and Simpson (2004) examined PECS and whether or not the number of spoken words and complexity of spoken utterances increased in three children with ASD and developmental delays. All three children progressed in mastery of PECS as well as the number of spoken words. All participants also used higher level words and sentences throughout learning PECS.

In terms of receptive language, results are not as strong. Ganz et al. (2015) explored the relationship between PECS and receptive language identification. Two of the target words showed improved receptive language across one child with ASD, but this was only a slight increase. There was no spontaneous connection between the spoken word and the picture, which seems normal due to the delayed receptive language in many children with ASD. Less research has focused on speech production when implementing SGD's.

iPad and Communication

Many AAC options exist for teaching communication to children with ASD, with the iPad emerging as the most effective, as well as other Speech Generating Devices (SGDs). Researchers have been exploring utilizing the iPad to teach children how to get their wants and needs met, how to discriminate pictures on the iPad, and also how to increase social and conversational skills (Gevarter et al., 2013; Logan et al., 2017; Lorah et al., 2014; Lorah, Parnell, et al., 2015; Lorah, 2018; Lorah et al., 2018; Thiemann-Bourque et al., 2017; Van der Meer et al., 2013; Xin & Leonard, 2015). Systematic reviews affirm that the iPad is an effective medium

for teaching children with ASD how to communicate their wants and needs, and recent literature is expanding to include tacting (i.e., labeling), as well as intraverbal (i.e. conversational) language skills via the iPad (Lorah, Karnes, et al., 2015; Lorah, Parnell, et al., 2015; Schlosser & Koul, 2015). See Table 4 for all articles regarding SGDs.

Table 4

All articles regarding SGDs

Authors	Diagnoses	Number of Subjects	Age of Subjects	Research Design	Intervention/ Measures	Outcomes
Lorah, Parnell, et al. (2015)	ASD, ID, ODD, DD	17 studies	2-23 years old	Systematic Review	Various ways to introduce SGD	The use of SGD has an emerging evidence base, mands are mainly being taught with SGD
Schlosser & Koul (2015)	Autism	26 studies	3-21 years old	Systematic Review	SGD's as part of a treatment package	Effective to improve mand repertoire and reduce challenging behavior, student preference must be considered when implementing
Lorah et al. (2014)	Autism	4	4-6 years old	Multiple probe with changing criterion	Symbol discrimination training on the iPad	Effective discrimination between picture symbols for all participants on the iPad
Gevarter et al. (2014)	Autism	3	3 years old	Multielement Design	Least-to-most prompting with time delay on iPad	Configuration of display on iPad screen format may impact acquisition rates
Lorah (2018)	Autism	3	3-4 years old	Multi baseline with changing criterion	Symbol discrimination training on the iPad	Discrimination can be taught in conjunction with a mand repertoire
Lorah & Parnell (2017)	Autism	3	3-4 years old	Multiple baseline across participants	Time delay with physical prompting to teach tacting on the iPad	All participants acquired at least one tact via the SGD in a group setting
Thiemann-Bourque et al. (2017)	Autism	6	4 years old	Multiple probe across participants	Peer-mediated training to use the SGD	Typically developing peers can be taught to use the SGD, moderate effects on peer-directed communication for those with ASD
van der Meer et al. (2013)	Autism	2	10-11 years old	Alternating treatments	Least-to-most prompting to select the correct item on AAC devices	Moderately successful for two and three step requesting on the SGD due to no set mand repertoires prior to intervention

Xin & Leonard (2015)	Autism	3	10 years old	Multiple baseline	Time delay to learn social communication on the iPad	Students learned to request with reduced prompting. Social skills improved but prompts were not able to be faded
Lorah, Karnes, et al. (2015)	Autism	2	8 and 12 years old	Multiple baseline across target behaviors	Time delay with full physical prompting to teach intraverbal speech via an SGD	iPad and prompting procedure were effective in acquiring some intraverbal language
Alzrayer & Banda (2017)	N/A	N/A	N/A	Descriptive guidelines	Guidelines	Set of guidelines for implementing SGD's
Boyd et al. (2015)	N/A	N/A	N/A	Descriptive guidelines	Guidelines	Set of guidelines to evaluate using the iPad and apps
Hill & Flores (2014)	Autism and DD	5	3-9 years old	Alternating treatments	PECS and PECS on the iPad	Students responded differently to each communication type, showing low tech may be effective and participants may prefer low tech
Lee et al. (2015)	Autism	2	2 and 4 years old	Alternating treatments	DTT to teach simple actions with and without the iPad as support	Students preferred condition using the iPad, however it only resulted in a slight reduction in challenging behavior

Mand Repertoire

Much research via the iPad has focused on teaching a mand repertoire (Skinner, 1957). This involves teaching children to request preferred items via various applications. Through the paucity of research that has been conducted, the iPad has been shown to be an effective vessel for nonverbal children with ASD to get their wants and needs met. Lorah, Parnell, et al. (2015) evaluated 17 studies that included the iPad as an SGD. All studies were evaluated based on the Horner et al. (2005) quality indicators for high quality single case design. Of these 17 studies, 14 of them utilized the Proloquo2Go application. 16 of the studies involved teaching a mand repertoire via the SGD, and only three went beyond manding to teach tacting. One important facet of all studies included social validity and evaluating the preference of the students

involved. Utilizing a device that the students preferred was likely to increase their success with the device, showing the importance of preference assessments, as well as the importance of utilizing devices that children are familiar with (Lorah, Parnell, et al., 2015).

Schlosser and Koul (2015) also completed a review of SGD use in children with ASD. 26 studies were included, many of which included the SGD as a treatment package to improve a mand repertoire as well as to reduce challenging behavior. They found that preference assessments were critical to the success of those involved, and decisions should be made based on the child's preference. Requesting has much research behind it, but Schlosser and Koul (2015) suggest that more research is needed to fully compare SGDs with PECS without carryover effects (e.g., utilizing the same picture for both systems).

Outside of teaching basic requesting skills and mand repertoire, others have looked at discrimination on the device in order to assist with more choice making, and some have examined the differences that occur between devices and design of the applications**.** Lorah et al. (2014) assessed whether within stimulus prompts (i.e., using movement and position to prompt) and prompt fading were effective to teach picture symbol discrimination via the iPad. They assessed young children with ASD throughout a five-phase training procedure that taught discrimination of symbols on the iPad. Stimulus prompts were effective at teaching discrimination without response prompts needed. The researchers also found that the participants progressed through all phases quickly and were able to discriminate pictures on the iPad and therefore make more of their own choices.

Gevarter et al. (2014) also assessed whether children with ASD could acquire mands using two different applications on the iPad. They inquired into how acquisition and the rate of mastery were affected by the design and the display in three males with ASD. Each child

responded differently to each display, showing that display may affect acquisition as well as acquisition rates. This could mean that button placement affects acquisition, the way the pictures are displayed, or perhaps the application in general (Gevarter et al., 2014). In order to ensure results are consistent, researchers must utilize the same application as well as layout on the application for each participant in the study. Lorah (2018) also taught a discriminative mand repertoire via the iPad in order to replicate a previous study that taught discrimination. Lorah (2018) taught a discriminative mand repertoire in the natural environment, utilizing varying prompt strategies for three preschool children with ASD. Training in the natural environment was effective, as all participants discriminated between pictures with rapid acquisition rates.

Tacting

Beyond mand repertoires, few studies have focused on tacting (i.e. labeling) and teaching another form of communication for non-verbal individuals with ASD. Due to the lack of research in this area, many children are taught requesting ineffectively on the iPad, are not taught tacts, and are then only utilizing the iPad as an electronic picture without effective navigation skills within the application. Lorah and Parnell (2017) noticed this problem and taught tacting using the iPad with three preschool children with ASD. They utilized full physical prompting with five second time delays. All students acquired the ability to tact at least one of the targeted stimuli. This extends the research beyond only a mand repertoire, however the students only acquired one tact, which does not necessarily give them more access to their environment and more power over their own language. Lorah, Parnell, et al. (2015), as stated above, only found three articles that went beyond manding, which leaves much research to be done not only on teaching tacting via the iPad, but also on navigating the iPad more efficiently.

Social Interactions

Although much research has focused on mand repertoires, some has focused on utilizing varying verbal behavior skills (e.g. mands, tacts, intraverbals) via the iPad in social situations in order to improve the social skills of children with ASD. Thiemann-Bourque et al., (2017) combined a peer-mediated intervention and an SGD to see the effects on communication, reciprocal interactions, and engagement between nonverbal or minimally verbal kids with ASD. They also examined to what extent adding preferred toys and snacks to social contexts affected child and peer communication and levels of engagements. Three preschoolers with ASD as well as three typical peers were involved, and the researchers found increased peer interactions for the children with ASD with their peers. The ability to participate in social and communication exchanges were also improved (Thiemann-Bourque et al., 2017).

Van der Meer et al. (2013) attempted to discover if students with ASD learn more complex socially oriented communication skills with varying AAC systems and investigated preference for different AAC systems. Two children with ASD were taught two-step and three-step requesting, as well as basic communication skills (initiating greetings, answering questions, and using etiquette). The procedures for implementation were moderately successful, which may have to do with the number of skills attempting to be taught at one time, seeing as how the children did not have solid mand and tact repertoires to begin with. The researchers, however, did find that the student's preference for the SGD they used remained consistent throughout time, indicating that once a student gets used to a certain SGD, they are successful with it over time.

Xin and Leonard (2015) bridged the gap between expressive skills and social skills. Utilizing least-to-most prompting, they attempted to teach students to increase spontaneous

communication on the iPad. Initial requests via the SGD increased with reduced prompts, but requesting without prompts was more difficult to attain. Overalls, skills improved in making social comments, however it was difficult to fully reduce prompts for initiating.

When looking at the highest form of social interaction and language from a behaviorist perspective**,** Lorah, Karnes, et al. (2015) taught intraverbal responding (i.e., conversational skills) via the iPad to two children with ASD. They utilized a five-second time delay and were effective in teaching the ability to respond to intraverbal statements. Both participants acquired their response very rapidly. The researchers conjectured that the quick acquisition rate may be due to the iPad as an inherent reinforcer, however even if that was the case, the participants were engaging in conversational skills with peers.

Guidelines

While much literature has focused on implementing SGD devices with non-verbal children with ASD to increase verbal behavior skills, less research has focused on how the SGD is implemented, and what constitutes good applications or practices with the SGD. Alzrayer and Banda (2017) developed guidelines for teachers to support implementing AAC in their classrooms. These steps included assessing student related abilities, such as hearing and vision abilities, linguistic and prelinguistic skills, as well as motor skills, problem behaviors, and cognitive abilities. These suggested steps attempt to implement steps prior to use of the AAC devices in order to make the transition to the device smooth. Along with assessments prior to the device, Alzrayer and Banda (2017) also suggested that symbol assessment must happen. This includes assessing what symbols, symbol size, and symbol placement are the most appropriate for each student. Student preference must also be taken into account, including preference for the device and application. The authors also suggest utilizing systematic instruction along with data

collection and evaluation in order to ensure the device is being used correctly. This then leads to appropriate generalization of all skills taught in different environments.

Boyd et al. (2015) also wrote guidelines for utilizing SGD's, including the ability to customize programs, the requisite motor skills needed to use each application, the resources and time needed to teach the skills for the SGD, the research basis for popular software applications, and the cost and affordability. These guidelines are a general basis for utilizing SGD, specifically the iPad, but do not touch on how to implement actual communication steps on the device. While useful and necessary, they are precursors to the implementation, and not actually about implementing varying communication protocols.

Social Validity

As many previous studies have suggested, social validity plays a large part in implementing an SGD with children with ASD. Not only must the child show preference for a device, but also the family, teachers, and peers. Utilizing an SGD that the student prefers increases the likelihood that the student will find success, and also increases the likelihood that the teacher, parents, and those in the community will encourage use of the SGD as well as have knowledge of how to implement applications. Hill and Flores (2014) compared the iPad to the Picture Exchange Communication System (PECS). The participants had different preferences throughout, showing that one cannot assume students will all gravitate toward the same device or medium.

Lee et al. (2015) considered two males with ASD in order to determine whether use of the iPad may contribute to more on task behavior as well as a reduction of challenging behavior. Students challenging behavior decreased, and when given a choice of AAC, both students chose the iPad. This preference for the iPad may in turn reduce challenging behaviors, as students are

more inclined to work and spend time on a device they prefer. This preference also carries over to parents and professionals, as those that have a positive attitude toward the iPad tend to utilize it more with their children (Clark et al., 2014). Lorah et al. (2018) also suggest the need for social validity to be conducted with stakeholders in order to determine preference.

Though research has focused on utilizing iPads in ways to encourage communication for children with ASD, they are not yet being used with effective steps to teach communication skills for children with ASD. As Ganz (2015) wrote, "there is a need for development and efficacy research that incorporates or packages communication interventions into protocols specifically designed to meet the unique needs of people with ASD and complex communication needs" (Ganz, p.209). Lorah et al. (2018) also discuss the need for a standardized set of instructions that will guide implementation of the iPad as well as implementation of Proloquo2Go.

iPad and PECS

While much research has focused on PECS and the iPad each as viable practices for teaching communication to children with ASD, some has also focused on comparing the two in order to determine if one is more effective than the other (Agius & Vance, 2016; Couper et al., 2014; Hill & Flores, 2014; King et al., 2014). Acquisition rates as well as preference is often measured. See table 5 for all articles regarding the iPad and PECS.

Table 5

All articles regarding PECS and the iPad

Authors	Diagnoses	Number of Subjects	Age of Subjects	Research Design	Intervention/ Measures	Outcomes

Agius & Vance (2016)	Autism	3	6 and 9 years old	Multiple baseline with adapted alternating treatments	PECS and PECS on an SGD	Both AAC systems were acquired and successful for requesting, and speed of acquisition was relatively similar between the two
Couper et al. (2014)	Autism	9	4-12 years old	Alternating treatments and multiple baseline	DTT to teach PECS, SGD or Manual Sign	5/9 children reached criterion with all three options, MS showed difficulty for two participants, 8/9 participants preferred the iPad
Hill & Flores (2014)	Autism and DD	5	3-9 years old	Alternating treatments	PECS and PECS on the iPad	Students responded differently to each communication type, showing low tech may be effective and participants may prefer low tech and both are effective
Gevarter et al. (2013)	DD (Autism, ID)	28 articles	M=10 years old	Systematic Review	Aided and unaided AAC intervention	Both aided and unaided AAC were effective and acquired quickly, participants preferred SGD's, and SGD's were acquired quicker than manual sign.

Agius and Vance (2016) examined the use of the iPad and PECS to develop requesting skills as well as navigational skills with preschoolers with ASD. Three preschoolers with ASD were taught both systems, and learned to request via both systems. All three achieved mastery in a relatively short period of times, but more prompting was required in order to master the iPad to teach exchanging the device before activating the speech. Preference was assessed during baseline, and all children chose the iPad. During intervention, the iPad was selected most often, but at times children chose the PECS book. This could be due to mastery of the PECS steps with less prompting than the iPad.

Couper et al. (2014) attempted to replicate past research comparing sign language, picture exchange, and the iPad as the SGD. Nine children with ASD were taught to use all three AAC options. Five reached mastery on all three systems, two struggled with sign language due to motor skills, while two did not reach mastery on any system. When assessing preference, they found that eight of the nine children (one dropped out during the study) preferred to use the iPad.

Four of the children that preferred the iPad had quicker acquisition rates via the iPad, showing that preference may indicate quicker acquisition rates. Both picture exchange and the iPad emerged as viable options to teach requesting and communication, yet the iPad was preferred by the large majority of children in the study.

Hill and Flores (2014) also looked at the iPad and PECS with five children with ASD. One child succeeded more with PECS, three with the iPad, and one with both. Both systems were useful depending on the student using it. The iPad was a more streamlined way of communicating, but the researchers assert that children may only prefer it once they have a streamlined way of communicating.

Gevarter et al. (2013) completed a review of 28 single subject research studies involving different types of AAC. A variety of both aided and unaided AAC devices were effective at teaching communication to individuals with ASD. Aided systems, such as SGDs, were acquired quicker and preferred by user's over manual sign. AAC did not hinder vocalizations and most participants preferred utilizing the SGD.

Not only are both PECS and the iPad effective systems to teach communication and requesting, but children acquire skills on both relatively equally. Children, however, may prefer to use the iPad, which may in turn affect their acquisition rate. Just as well-trained teachers may affect the implementation of PECS, well trained teachers on a well task-analyzed protocol may affect the implementation of a communication protocol via the iPad (Agius & Vance, 2016; Couper et al., 2014; Hill & Flores, 2014).

Research Designs for Communication Interventions

When PECS was first introduced, it was implemented as action research and not formally evidence based (Bondy, 2012). As research has been conducted to suggest the viability of PECS,

many have been conducted with either multiple baseline or changing criterion designs (Beck et al., 2008; Dogoe et al., 2010; Ganz et al., 2005; Ganz & Simspon, 2004; Lorah, 2018; Lorah et al., 2014; Marckel et al., 2006; Shrestha et al., 2013; Yokoyama et al., 2006). Seeing as how PECS is taught in a forward chaining method, the changing criterion design has been utilized often when looking at the individual phases of PECS. See Table 6 for all articles regarding research design.

Table 6

All articles regarding research design

Authors	Diagnoses	Number of Subjects	Age of Subjects	Research Design	Intervention/ Measures	Outcomes
Ganz & Simpson (2004)	Autism	3	3-7 years old	Changing Criterion	PECS	All participants made progress in mastering PECS, spoken words increased. And skills were generalized to multiple people
Marckel et al. (2006)	Autism	2	4 and 5 years old	Multiple baseline with changing Criterion	PECS with descriptors	Descriptors increased for both participants within the use of PECS
Beck et al. (2008)	Autism	4	Preschool Age	Alternating treatments	PECS and PECS on voice output devices	All participants learned some phases of PECS, the VOCA showed some success but the weight of the device made it difficult for all participants
Ganz et al. (2005)	Autism	1	5	Case Study	PECS	PECS was effective but only with modifications for the subject
Yokoyama et al. (2006)	Autism	3	5-7 years old	Multiple baseline across participants and changing criterion within participants	PECS	All subjects acquired PECS through phase IV and generalization across space and people
Dogoe et al. (2010)	Autism	3	3-5 years old	Multiple baseline across participants	PECS	All participants mastered through PECS phase IIIB with high acquisition rates
Lorah (2018)	Autism	3	3-4 years old	Multi baseline with changing criterion	Symbol discrimination training on the iPad	Discrimination can be taught in conjunction with a mand repertoire
Lorah et al. (2014)	Autism	4	4-6 years old	Multiple probe with changing criterion	Symbol discrimination	Effective discrimination between picture symbols for all participants on the iPad

Shrestha et al. (2013)	Autism	1	4 years old	Changing Criterion	training on the iPad POV video modeling and a forward chain	Participant learned to make himself a snack and clean up after himself

Ganz and Simpson (2004) examined the role of PECS in spoken words, as well as a potential decrease in non-word vocalizations. Researchers looked at three children diagnosed with ASD and implemented a single case, changing criterion design. In order to advance to a new phase of PECS, participants had to show proficiency at the current phase with 80% or higher responding for three consecutive sessions. PECS was implemented as originally described by Bondy and Frost (1994), and all three participants progressed through the phases of PECS. All three participants also demonstrated increases in intelligible words spoken per trial. By breaking each phase into a set criterion, researchers were able to see which phase the participants struggled the most with which was phase four across all participants.

Marckel et al. (2006) also conducted a single case changing criterion design to assess the effectiveness of PECS on using descriptors and to see to what extent the results generalized. They set criterion at 90% responding across all trials for three consecutive sessions. The criterion were not the phases of PECS, but rather increase in the number of descriptors that were required within the PECS phases. They utilized the changing criterion design within multiple baseline, across two young boys (aged four and five) diagnosed with ASD. All participants increased the descriptors used within PECS.

Beck et al. (2008) conducted an alternating treatments design, comparing PECS and voice output communication aids (VOCAs). They conducted intervention sessions with four non-verbal or limited speaking preschoolers who did not currently use AAC. The researchers were attempting to find out which method was more effective, and how PECS influenced

verbalizations compared with VOCAs. Although they conducted an alternating treatments design, changing between PECS and VOCA, they set criterion changes in order to move between phases within PECS. Criterion was set at 80% correct responding on the current PECS phase for two out of the three consecutive days. Once criterion was reached, a new PECS phase was introduced, in a forward chain. All three participants progressed through some phases of PECS, aligning with past research that PECS phases may be acquired quickly.

Ganz et al. (2005) conducted a case study across one five-year-old girl diagnosed with ASD. They began their research in order to, again, see the effect of PECS on speech production. The subject was unable to master PECS, so the authors delved into a modification of PECS to see if variations were possible. They introduced PECS phases with variations made in order to suit the participant. She was also required to stay at 80% of independent correct responses for approximately three sessions before moving on to the next phase of PECS. Their design was, noticeably, a case study, and therefore the authors did not specify whether or not this was a true changing criterion design.

Yokoyama et al. (2006) also evaluated PECS implementation with three young children diagnosed with ASD. They utilized a multiple-baseline across participants as well as changing criterion within participants. They assessed each participants ability with PECS in baseline, which determined which steps of PECS they introduced first. Each participant was introduced to a new phase of PECS after achieving a minimum of 75% completion on various components of PECS (e.g., reaching, discriminating, exchanging). The researchers also assessed generalization of the introduced PECS phases to novel persons, more distance, as well as within a time delay. All three participants acquired PECS phases I-IV within this design.

Dogoe et al. (2010) implemented PECS in a multiple baseline across participants design. Within this design, participants were required to achieved 80% correct responding across a 10-minute interval in order to move on to the next phase in PECS. Two participants received intervention three days a week, while one received intervention two days a week. All participants acquired PECS quickly, and progressed up to phase IIIB in PECS successfully.

Within research involving the iPad as the SGD, Lorah (2018) utilized a multiple baseline design across participants within a changing criterion design. The researcher implemented various phases on the iPad to replicated a previous study that taught discrimination training of pictures on the device. Criterion for each phase was set at 80% independent and correct mands within the 30-minute interval across two consecutive intervention sessions. All three participants learned a discrimination repertoire at the same time they were learning a mand repertoire, ad learned within their natural environment. In the original study, Lorah et al. (2014) implemented a multiple probe design with changing criterion in order to teach discrimination training on the iPad. Criterion was again set at 80% independent and correct mands over the training time period to move onto to the next change in criterion.

In regards to forward chaining, Shrestha et al. (2013) introduced self-help skills to a four-year-old boy diagnosed with ASD. A forward chain with video modeling was used to teach the participant to prepare, serve, and clean up cereal for himself. The steps of the task analysis were broken into chunks, including setting up, eating, and cleaning. Criterion for each phase was set at three consecutive sessions with 100% accuracy and no prompting. Video modeling was effective at teaching, and the participant went through the phases at criterion quickly. Within the forward chain, the steps to complete the entire task were taught one after the other, until the entire task analysis was completed.

Much research in the field of communication training and, specifically, PECS, focuses on introducing steps in a forward succession, notably a forward chain. The changing criterion design allows for stepwise progression of introducing an intervention, and when evaluating specific steps of PECS, this seems an appropriate design to implement. Although introducing PECS in a forward chain does not give access to all steps of PECS throughout, the changing criterion design allows for students to increase to a new phase of PECS after mastering the criterion set at the current phase (Beck et al., 2008; Dogoe et al., 2010;Ganz et al., 2005; Ganz & Simspon, 2004; Lorah, 2018; Lorah et al., 2014; Marckel et al., 2006; Shrestha et al., 2013; Yokoyama et al., 2006).

Conclusion

Children with Autism Spectrum Disorder (ASD) struggle with communication, whether verbal or non-verbal, as a hallmark of the disability (APA, 2013). The Picture Exchange Communication System (PECS) has shown much success in increasing communicative attempts for non-verbal children with ASD (Bondy & Frost, 2001; Charlop-Christy et al., 2002; Flippin, Reszka, & Watson, 2010; Ganz et al., 2012; Greenberg et al., 2012; Lerna et al., 2014; Ostryn et al., 2009). PECS involves exchanging laminated pictures of items for the actual desired item with a communicative partner in order to communicate a want or need. There are six phases of PECS, that begin with understanding the exchange, and end with intraverbal (i.e., conversational) speech.

Along with PECS, research is emerging on the iPad being an effective device to encourage and teach functional communication for children with ASD. Multiple applications exist on the iPad that provide non-verbal children with the opportunity to communicate their

wants and needs via the iPad as a Speech Generating Device (SGD) (King et al., 2014; Lorah et al., 2013; Lorah, Parnell, et al., 2015; Lorah & Parnell, 2017; Lorah, 2018).

The iPad has emerged as the most readily available SGD, as well as one of the most versatile (Lorah et al., 2018). With the application Proloquo2Go, children can learn to fully communicate with either words, tiles, or sentences. Since Proloquo2Go has become a viable application, there has yet to be a standardized way to introduce this application to children with ASD (Boyd et al., 2015; Lorah et al., 2018). Teachers and clinicians often implement the PECS protocol on the iPad; however, the PECS protocol does not take into account the nuances of the iPad, nor do they teach children how to fully navigate the iPad.

Much research conducted on both PECS and SGDs is conducted with a multiple baseline or changing criterion design (Beck et al., 2008; Dogoe et al., 2010; Ganz et al., 2005; Ganz & Simspon, 2004; Lorah, 2018; Lorah et al., 2014; Marckel et al., 2006; Shrestha et al., 2013; Yokoyama et al., 2006). Utilizing a stepwise introduction of PECS or the iPad allows for each step to be analyzed on its own, in order to see if any deficits occur in the phase itself, rather than the entirety of the intervention. Seeing as how PECS is taught in a forward chain, this also allows for a criterion to be set in order to advance to through each phase (Beck et al., 2008; Ganz & Simspon, 2004; Shrestha et al., 2013)

Although both traditional PECS and applications on the iPad have research to support their use with children with ASD to encourage communication, the iPad does not yet have well established phases or steps on how to teach communication to children. The six phases of PECS are often applied on the iPad, and do not teach the nuances of utilizing an electronic device. Instead, the iPad is merely used as an electronic picture, and children with ASD are not taught how to navigate the iPad independently. Also, rarely are children taught how to speak or

manipulate sentences on the iPad, and truly use it as an SGD that has the ability to lead to true intraverbal speech.

Chapter Three: Methodology

Children with ASD often struggle to communicate effectively to get their wants and needs met in an efficient manner (APA, 2013; Tager-Flusberg & Anderson, 1991). Rather than using vocal speech, many children resort to gestures to communicate with familiar persons (Braddock et al., 2016; Camaioni et al., 1997). Not only are gestures often only recognized by those familiar to the child, but they are also often only useful for items that can be seen in the immediate environment (Camaioni et al., 1997).

Communication interventions, such as PECS and Speech Generating Device's (SGDs) have emerged as useful forms of alternative communication for individuals with ASD. However, due to the novel nature of the SGD, there is currently no standardized way to introduce communication training on the device. When teaching PECS on the iPad, the iPad is merely used as an electronic picture; this does not give the child the tools to utilize all the nuances of the SGD.

This study attempted to discover if graduated guidance was (a) successful in teaching a forward chained task analysis via the iPad to increase communicative attempts in children with ASD and (b) if this task analysis on the iPad was subsequently used more frequently than gesturing. If the task analysis on the iPad was used more frequently than gesturing, BCBAs, RBTs, and the general population could begin to teach communication with the iPad from the start. Using a task analysis provides a systematic introduction to the SGD as a whole, thereby eliminating the need for prerequisite interventions to be completed prior to introducing the iPad.

This study focused on increasing communicative attempts via the iPad, while simultaneously recording gesture use, to demonstrate whether or not the iPad became a prominent communication device. The task analysis included steps that teach navigation of the

device, early use of the device, as well as the communicative exchange with others and generalization. This task analysis was taught via graduated guidance.

Research Questions

When utilizing the iPad and implementing communication training, research does not currently demonstrate a standardized set of steps to effectively teach children how to navigate the iPad or the application the children will use (Gevarter et al., 2014; Logan et al., 2017; Lorah et al., 2014; Lorah et al., 2015; Lorah, 2018; Lorah et al., 2018; Thiemann-Bourque et al., 2017; Xin & Leonard, 2015). The research questions addressed in this study were:

1. Is graduated guidance effective in teaching a forward chained task analysis on the iPad, and effective at increasing communicative attempts in children with ASD?
2. Does student implementation of the steps of the task analysis used in this study result in more frequent use of the iPad when compared to gesturing to communicate wants and needs?
3. Do the parents and RBT's think that the iPad-based graduated guidance intervention is effective at increasing communicative exchanges in students with ASD?

Participants

The participants in this study were four young children diagnosed with Autism Spectrum Disorder (ASD). All children were receiving services based in Applied Behavior Analysis from a private clinic in the southwestern United States. Participants were all between the ages of two and five years old.

Participant Inclusion

Participants were included if they a) had a diagnosis in the category of Autism Spectrum Disorder; b) were receiving services based in Applied Behavior Analysis; c) had a

communication goal on their current treatment plan; d) had a minimum score of emerging level two on the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP) e) and history with the Picture Exchange Communication System (PECS) exclusion criteria.

Diagnostic Instruments

To participate in this study, participants had been previously diagnosed as having ASD via one of the following assessment tools: The ASD Diagnostic Observation Schedule (ADOS), The Childhood ASD Rating Scale (CARS), or the Gilliam ASD Rating Scale (GARS). The ADOS, CARS, and GARS are instruments utilized to diagnose ASD. On these assessments, a set of interviews and observations are conducted to assess the deficits and excesses a child may present, with a score given following these observations (Randall et al., 2018). To participate in this study, each child needed an ADOS score between five and eight, a CARS score between 30 and 40, or a GARS score of Very Likely as well as no more than two standard deviations from the norm ASD Index. Diagnoses were given prior to entrance by assessors not involved with the study (e.g., medical doctors, school psychologists). Clinicians working at the ABA clinic where children were recruited from reviewed diagnostic documentation to verify that students had an ASD diagnosis.

Verbal Behavior Milestones Assessment and Placement Program

The VB-MAPP is a tool designed to guide instruction on verbal behavior and assess a child's level of functioning regarding verbal behavior (e.g., mands, tacts, intraverbals) (Barnes et al., 2014). The VB-MAPP is composed of five sections, however only scores on the Milestones Assessment were utilized. A minimum score of emerging level two was required for participation. The VB-MAPP assessment was performed by the BCBA working with the child before recommending participants.

Treatment Plan Goals

Participants all had a minimum of one treatment plan goal addressing a communication deficit. Treatment plans are written by BCBA's for each client, and sent to the appropriate funding sources (e.g., insurance, state, funding). They include goals for the client, as well as parent training goals. Participants were all nominated by a Board-Certified Behavior Analysts (BCBA), utilizing all included criteria. The treatment plan was analyzed by the BCBA in charge of each child's specific case in order to determine whether or not a student was eligible.

History with Interventions

All children that participated in the study had limited to no experience with PECS. Parents were interviewed on PECS usage in the child's past. Participants were included if they have never been introduced to PECS. Interview questions can be found in Appendix A.

Participant Exclusion. Students were not included if they were under two years old or above five years old and: a) had a treatment plan with no communication goals, b) had an ADOS score under five or above eight, a CARS score below 30 or above 40, or a GARS score more than two standard deviations above the ASD index, c) were verbal (e.g., use more than five vocalizations from their mouth in the form of words to communicate their wants and needs), d) had used or been taught any phases of PECS, e) had any comorbid disability other than a Specific Language Impairment (SLI), f) were absent more than 15% of their scheduled sessions prior to intervention beginning, g) lacked parental consent, and h) did not provide assent. See participant demographics below in Table 7.

Table 7

Participant demographics

Participant Demographics					
Participant	Age	Sex	Diagnosis	Race	Ethnicity
Jack	5y, 3mo	Male	ASD	Asian American/White	Not Hispanic/Latino
Larry	5y, 10mo	Male	ASD	White	Not Hispanic/Latino
Jessica	3y, 7mo	Female	ASD	Hispanic/Latino	Hispanic/Latino
Jim	4y, 8mo	Male	ASD	Hispanic/Latino	Hispanic/Latino

Jack. Jack was a five-year, three-month-old boy nominated by his BCBA for meeting all above mentioned criteria. Jack's parents indicated that he had no prior history with PECS, and no formal communication training. He used gestures and some attempts at vocalizations to get his wants and needs met. Jack's RBT had some experience with PECS, but no formal training with utilizing an SGD.

Larry. Larry was a five-year ten-month-old-boy nominated by his BCBA for meeting all above mentioned criteria. Larry's parents indicated that he had no prior experience with PECS, and primarily used gestures to get his wants and needs met. Larry's RBT had prior experience with PECS, SGD, the iPad and the Proloqo2Go application.

Jessica. Jessica was a three-year seven-month-old girl nominated by her BCBA for meeting all above mentioned criteria. Jessica's parents indicated that she had no prior experience with PECS, and no other form of functional communication training. Jessica's RBT indicated

that she had some training with PECS, and had used an iPad before, but never to implement training with the Proloquo2Go application.

Jim. Jim was a four-year eight-month-old boy who was nominated by his BCBA for meeting all above mentioned criteria. Jim's parents indicated that he had no prior experience with PECS, and no other form of functional communication training. Jim's first RBT indicated that she had some training with PECS, as well as some training using Proloquo2Go on the iPad. Jim's second RBT indicated that she had some prior experience with PECS phase 1 and had used the iPad and Proloquo2Go for requesting and expressive programming in the past.

Parent and RBT Recruitment and Training

Parents and RBTs were key participants throughout the intervention. Parents and RBTs were included if they were currently working or living in the home of a current client receiving in person services that assents to intervention. Parent and RBT training included training on all phases of the protocol, including practice, role play with each other, examples and non-examples, and feedback following practice. RBT's were utilized as the communicative partner (i.e., the partner the child is exchanging the iPad with) and parents were the silent prompter (i.e., the person facilitating the exchange). A checklist can be found in Appendix C with all steps involved in teacher training and implementation. All trainings happened virtually, when the RBT and parent were both in the home with the child. Times were agreed upon by the parent and RBT, and took place during a session that was already scheduled to happen with the child via the clinic. Each parent and RBT duo had their own time slot. RBT's were also interviewed on their experience with use of the iPad as an SGD as well as their use with PECS. Interview questions can be found in Appendix B.

Interobserver Data

All intervention and baseline sessions were recorded. Interobserver agreement data were collected for 31% baseline and intervention sessions. One observer was the author of the study, who has a Master's degree in Special Education, as well as 13 years of experience working with children on the autism Spectrum. The second observer was a doctoral student who has a Master's degree in Special Education, as well as 12 years of experience working with children on the autism spectrum. The observer was trained on the procedural fidelity checklist, as well as how to take data on each sheet. The observer watched a video with the researcher, where both went over the steps of the checklist, and what was the exact response criterion. Both the researcher and the interrater achieved 100% fidelity. Sessions were recorded, then data were taken by the interobserver.

Setting

The intervention took place in the homes of each child participating in the study. As each home environment is structured differently, the only requirement for each participant's therapy area was a table and chairs. The participant sat in their typically used chair at the table, facing the RBT that acted as the communicative partner. The silent prompter (i.e., parent) sat or stood behind the participant. The intervention was implemented by the parent/guardian of the child as well as the RBT currently working with the client. The intervention took place for 10 minutes of the client's already scheduled session, for a total of 20 sessions (Dogoe et al., 2010; Ganz et al., 2005; Lorah & Parnell, 2017; Xin & Leonard, 2015). The amount per week varied due to the client's current therapy schedule as well as COVID-19 restrictions (i.e., some children received intervention four days a week, and others five). However, all children received the same amount of sessions as well as time within each session. Since all RBT's and parents were already in the

home with the child, no additional COVID protocols were included other than what the clinic already had in place (e.g., temperature checks, sanitation of the area, wearing masks).

Materials and Equipment

Technology

A 10” Apple iPad fitted with a case was used for each participant was provided to each child by the clinic through which services were being provided. Each participant used an individualized iPad that was be designated solely for communication. Each iPad was also equipped with Proloquo2Go, a speech generating software that includes picture tiles, words, typing ability, and folder manipulation. Proloquo2Go comes equipped with a core vocabulary, clip art pictures, and folders readily made. This software was individualized for each participant, with their own pictures and tiles that match their particular functioning level. Proloquo2Go also has a full keyboard to allow for typing and has the ability to speak either single words or sentences made up of word tiles or typed out sentences. Proloquo2Go easily transitions from picture tiles, to word tiles, to typing, making it easy to teach to students and easy to use for professionals.

After Proloquo2Go was installed, pictures were taken via the iPad of the real-life item that the child requested during the preference assessments. All pictures were of the tangible item on a neutral background in order to ensure sameness between all pictures. Although pictures were not used in the first steps, they were saved in the storage folder for immediate use when necessary. Each day that a preference assessment was conducted, new pictures were taken of those items and added to the storage folder.

Reinforcers

Following each exchange of the iPad with the communicative partner, the desired item chosen by the student was immediately exchanged. Reinforcers varied for each child but included toys (e.g., cars, trains, slime) or edibles (e.g., cookies, crackers). Reinforcers were items that were readily available in the home. Preference assessments were conducted with each student prior to each baseline and intervention session. Free operant and/or multiple stimulus without replacement preference assessments were completed, and each RBT kept a list of items chosen, including a hierarchy of preference. The preference assessment data sheet can be found in Appendix D. Procedures to conduct preference assessments are described below.

Data collection materials

Discrete trial data sheets were kept in a binder for each student, including data sheets for preference assessments, data on number of communicative attempts, frequency data on gestures, procedural fidelity data, and social validity data. Discrete trial data on each intervention step was also completed by the researcher after viewing the videos of all recorded sessions. All data sheets were the same for each student. Frequency data sheets were also be kept for gestures. Data were completed on paper with a pencil. Videos were also kept of each of the sessions. See data sheets in Appendix E.

Dependent Variable

The dependent variables within this study were the steps on the task analysis, communicative attempts on the iPad, and communicative gestures. Responses were recorded on communicative attempts via the iPad on the current step, and correct responses were recorded when the child made a communicative attempt while following all criterion for the current step without prompting. All responses were recorded on the discrete trial data sheets. See the data sheets in Appendix E. A “C” was circled for a correct response, an “I” was circled for an

incorrect response, and a “P” was circled for a prompted response. The step the participant is on was notated as well as what reinforcer was being used.

Response Definitions

In step one, communicative attempts were counted any time the participant independently exchanged the blank iPad desired item. In step two, communicative attempts were counted any time the participant independently touched the home screen, swiped up to open the iPad, and exchanged the iPad for reinforcement. In step three, communicative attempts were counted any time the participant independently touched the home screen, swiped to open the iPad, clicked the picture of the desired the item, and exchanged the iPad for reinforcement. In step four, communicative attempts were counted any time the participant independently touched the home screen, swiped to open the iPad, clicked the “I want” icon and the picture of the desired item, and exchanged the iPad for reinforcement. In step five, communicative attempts were counted any time the participant independently touched the home screen, swiped to open the iPad, clicked the picture of the desired the item, clicked the sentence strip, and exchanged the iPad for reinforcement. In step six, communicative attempts would have been counted any time the participant independently touched the home screen, swiped to open the iPad, clicked the picture of the desired the item, clicked the sentence strip, and exchanged the iPad for reinforcement with a novel member of their household. Communicative attempts were not counted throughout all steps if the participant utilized a PECS book, pointed or gestured to the desired item, or grabbed the desired item. Gestures were counted when the participant utilized their body (e.g., arm, finger, hand) to gesture (e.g., points, waves, pulls the RBT) toward a desired item that was presented following a preference assessment. This included showing the RBT where the item was by pulling the teacher toward the item, pointing at an item, waving at an item, or moving

their body toward an item. Gestures were not counted when the student threw or looked at an item.

Intervention

Independent Variable

The independent variable was graduated guidance to teach a task analysis to facilitate communication on the iPad. See the task analysis in Appendix F and the prompting hierarchy demonstrating graduated guidance in Appendix J. A forward chained task analysis was implemented via graduated guidance in order to teach students with ASD how to communicate on the iPad. Prompting started with the most intrusive level and graduated to the least intrusive level. Prompting level, one began with full physical prompting to complete the step and exchange the iPad. Step two was less intrusive, by physically prompting to complete the step but not to exchange. Step three was to tap the child's arms to complete the step and exchange, and step four was only a point toward the iPad.

The task analysis included six steps, all of which introduced the child to the technology as well as taught them how to communicate via the iPad. Reinforcing items were exchanged following use of the iPad to increase communicative attempts. Reinforcing items varied for each participant. The task analysis steps included exchanging the iPad, turning on the iPad, pressing pictures on the iPad, utilizing an "I want" sentence started on the iPad, utilizing the iPad to speak a sentence, and generalizing the above steps to a new member of the household. Graduated guidance was used to implement this task analysis, which teaches each participant how to navigate the iPad and does not merely use the iPad as an electronic picture. A forward chaining procedure was used as each step precedes the next in order, and only one is taught at a time (Cooper et al., 1987). During the training phases, the percentage of correct responses during the

10-minute training period were graphed. Intervention took place for 20 days, with an average of four sessions being completed each week. Data were collected during the 10-minute period. Once a participant remained at criterion for 80% of the 10-minute period across two-consecutive training sessions, they moved onto the next criterion.

Experimental Design

A single case research design that most closely aligns with changing criterion was utilized for this study (Cooper et al., 1987; Ganz & Simpson, 2004; Gast & Ledford, 2014). A true changing criterion design would have allowed subjects access to all of the steps from the onset, and this design required that each step in the task analysis protocol was a criterion the student must master before moving onto the next step. Each training period was 10 minutes in length, and the percentage of correct responses was recorded during that 10-minute period. If the participant remained at 80% or above for two consecutive training periods at the current step, they had met the criterion and moved on to the next change in criterion. This design allowed for the progression of the forward chained task analysis throughout the study. Due to the complexity of the skills and the way each step builds upon the last, a forward chain was the best way to approach the task analysis (Smith, 1999). Not only are forward chains used to teach a complex skill, but they are more likely to be replicated in the classroom by teachers (Cooper et al., 1987). Utilizing a forward chain sets up the future likelihood of this task analysis being used by teachers in their classroom, as well as by clinicians in the home environment that are also familiar with chaining procedures. This forward chain also allowed for each step to be analyzed individually and to see if any steps presented with more difficulty than any others.

Baseline was carried out for five days (Horner et al., 2005), and until an obvious trend was present. Stability of data points across trend was determined prior to the beginning of

intervention, in baseline. In order to control for threats to internal validity, prior experience with PECS was considered of all participants, the instruments were the same throughout the duration of the study, the study was 20 sessions long which decreases the chances of change through maturation, and a procedural fidelity checklist of all steps was used.

Within this design, all participants were introduced to intervention following a baseline made up of five data points. Each baseline and training session was 10 minutes in length. The number of trials completed within those 10 minutes was dependent on each participants' success. If highly motivated, the child exchanged the iPad immediately in order to quickly receive reinforcement. This resulted in more trials being conducted in those 10 minutes than a child who was less motivated and required multiple prompts in a row.

Social Validity

Social validity data for parents and RBTs was collected. For parents and RBTs, a form was given following the intervention phase (see Appendix G). Questions for RBTs and parents included ease of use, perceived stigma of the device, preference of device (e.g., PECS versus iPad versus gestures), whether they will continue to use the device in the home environment, and how often they might continue device use. See the parent and RBT questionnaire in Appendix H. Due to the low receptive and expressive language of the children involved, social validity questionnaires were not given to the children.

Procedures

Pre-data Collection

Participants

Before beginning intervention, a letter inviting participation was sent out via email to all clients currently receiving in-person services. Following initial consent, the researcher collected

BCBA nomination of students based on the above criterion. Parents were interviewed regarding PECS usage in the child's past. Interview questions can be found in Appendix A. RBTs were asked their experience with use of the iPad as an SGD as well as their use of PECS during intervention. Interview questions can be found in Appendix B.

Consent/Assent. Following the letter sent out inviting participation, interested parents signed a consent form for the VB-MAPP to be performed in order to ensure eligibility criteria was met. Once this consent was obtained by all those interested, the BCBA working with the client nominated students to be involved based inclusion. BCBAs were given a list of all exclusion and inclusion criteria, as well as information regarding the study in order to assist with their nomination. Once eligibility of their child was confirmed, parents were invited to participate with their child. This invitation came in the form of an email. Following this invitation, a short meeting conducted via Zoom took place to explain the research with all interested participants and parents. A form was then sent home that detailed the following: what the intervention will include, how long the intervention will last, the potential risk/benefit, as well as information on the ability to leave the study at any time. Secondary consent was obtained that included the parents agreeing to participate in the research, as well as the RBTs agreeing to participate in the research. Once consent was obtained, students were given the opportunity to assent or dissent via a visual chart representing an emoji with a smile or an emoji with a frown. All children gave assent.

Parent and RBT Training

After BCBA nominations were concluded, all parents and RBTs attended a training in order to be fluent in the steps of the task analysis, as well as the procedural fidelity checklists and preference assessments. This training was conducted by the researcher and took place for one

hour via Zoom. The training occurred during a regularly scheduled session time when the RBT was already in the home with the child and parent. The training began with introducing preference assessments. Free operant preference assessments were demonstrated with items the child may prefer and were readily available in the home. The researcher demonstrated the preference assessment and how the RBT would take data on these assessments. Multiple stimulus without replacement preference assessments were then demonstrated, utilizing the same items. Practice took place in the same manner. If the parent or RBT performed a step incorrectly, feedback was given and the step was redone. The child was present during preference assessments, but not during any steps of the procedural fidelity checklist. Parents and RBT's performed the task to 100% fidelity by the conclusion of the training.

Following preference assessments, the researcher introduced Proloquo2Go on the iPad and demonstrated its capabilities to the parent and RBT (e.g., how to edit, how to take pictures, how to change pictures, etc.). A copy of the task analysis and procedural fidelity checklist was distributed out to all parents and RBTs for review; they were then asked to implement the steps of the task analysis to ensure full and complete understanding of the intervention. The researcher gave feedback on the implementation of the steps as necessary via Zoom.

Once all steps had been demonstrated, parents and RBTs demonstrated their respective roles (e.g., parent as silent prompter, RBT as communicative prompter) via role play. They repeated this process until they achieved 100% fidelity for two trials. High-P procedures (i.e., presenting easy to follow request in order to gain compliance with a more difficult to follow request) were explained to the RBT and parent. This included giving examples of likely behaviors they will utilize (e.g., simple non-verbal imitation, simple receptive instructions) as well as what behaviors this procedure might follow. Following all role play, the researcher

discussed challenging behaviors that could occur, and what types of differential reinforcement will be used. Examples and non-examples of appropriate redirection were discussed. Differential reinforcement procedures are described below. Feedback was given from the researcher in order to improve and to ensure the high-P procedures were conducted enough times to ensure attention was regained by the student. Due to the nature of an RBTs training, they were all proficient in high-p procedures as well as differential reinforcement. Both practices are commonly used in therapies based in Applied Behavior Analysis. All RBTs demonstrated each role with 100% accuracy before the training will be completed. This will ensure procedural fidelity is possible.

Interobserver Recruitment and Training

Before data collection began, an interrater observer was trained on all facets of the intervention. This included response definitions, the dependent variables being measured, as well as the data sheets being utilized. The interrater observer was a graduate student with four years of graduate school completed who held a BCBA credential. All sessions were recorded, and the observer watched 31% of videos to collect procedural fidelity data to ensure the procedures were being implemented in the same way during each day of the week. Session days chosen for review were placed in a hat and selected to ensure they were randomly selected.

Baseline Procedures

During baseline, the iPad was sitting out on the table, and all participants continued to get their wants and needs met in whatever manner they were previously doing so (e.g., gestures, pulling teachers toward the item). RBTs recorded the number and type of gestures made to get their wants and needs met, as well as data on any communicative attempts made via the steps on the iPad. Any time the child communicated successfully (i.e., gestured and received the desired item), the gesture type and item were recorded. Data were recorded utilizing a frequency count.

See data sheet in Appendix J. Data were not recorded on incorrect responses, as the goal was to increase communicative attempts. The RBT did not intervene and only took data on the child's communication within the therapy area. All participants remained in baseline until an obvious trend had occurred (e.g., increasing or decreasing with stability) and then intervention began for all participants.

Intervention Procedures

The independent variable was graduated guidance to teach a forward chained task analysis on the iPad. The six steps included on the task analysis not only introduced the child to the technology involved, but also introduced communication via the iPad. The task analysis included 1) exchanging the blank iPad for reinforcement, 2) pushing the screen on the iPad to turn it on, swiping up, and exchanging for reinforcement, 3) pressing an item that appeared on the iPad and exchanging for reinforcement, 4) pressing "I want" and the item that appears on the iPad and exchanging for reinforcement, 5) pressing the sentence after choosing "I want (item)" and exchanging the iPad for reinforcement, and 6) generalizing all previous steps to a novel person in the home. Graduated guidance was used to teach these steps and included four steps. These steps included: 1) a full physical prompt (i.e., hand over hand assistance to complete the step and exchange the iPad), 2) partial physical prompt (i.e., hand over hand assistance to begin the step without prompting to exchange the iPad), 3) partial physical prompt (i.e., tap the student on the arm to begin the step), and 4) gestural prompt (i.e., point to the iPad to begin the step). The prompting hierarchy always started with a Level 1 and continue to a Level 4, going from most to least intrusive. Once all four prompts had been conducted, the student attempted to respond independently. See the hierarchy in Appendix J.

Preference Assessments

First, preference assessments were conducted with each student immediately prior to implementing the task analysis. These included free operant assessments in which reinforcers were available around the teaching area; the RBT noted which items the child gravitated toward and played with, as well as how long the child stayed interested in the item (Cooper et al., 1987). The RBT began with four to five items in front of the participant. Once the child chose an item, they were allowed to play with the item. If the participant continued to play with the item for longer than 30 seconds, the RBT moved the other available items closer to see if the participant showed interest in any other items. This continued for two minutes. Also, Multiple Stimulus Without Replacement assessments were conducted, in which three or four items were displayed; once a child chose an item, it was not replaced. Instead, another item was set out to be chosen (Chazin & Ledford, 2016). The type of preference assessment used was dependent on the child and what they responded better to. Preference assessments took place with items readily available in the home and lasted for two minutes each. These took place before each training session throughout the entirety of the intervention. These assessments were performed in order to ensure the child was motivated to engage in communicative attempts with the communicative partner. See recording sheets in Appendix D. Second, each step in the task analysis was introduced via graduated guidance. All steps were introduced via a prompting hierarchy of most-to-least prompts. See the hierarchy in Appendix J.

Differential Reinforcement

After the child's reinforcing items were identified, each step in the task analysis was introduced in order (see procedural fidelity checklist in Appendix K). If a child engaged in inappropriate behavior during any phase of the intervention (e.g., crying, screaming, hitting, throwing, kicking, eloping) they were redirected back to the task via high-P procedures and

prompting through compliance (e.g., redirecting back to the chair by pointing or holding their hand). These high-P procedures looked like non-verbal imitation (i.e., the student imitates the researcher's simple movement) or receptive instructions (e.g., clap, knock, wave). The high-P procedures continued until the student displayed appropriate behavior as well as responding. This is a common procedure conducted within the child's typical ABA session that RBT's were already familiar with. They did not impact the intervention or when the child received the reinforcing items.

Differential reinforcement procedures (e.g., DRO, DRI, DRA) were also used to reinforce appropriate behaviors (Cooper et al., 1987). This is part of the regular therapy routine conducted within the child's normal ABA sessions. This included reinforcing behaviors that were incompatible with the inappropriate behavior, behaviors that served as a functional alternative to the inappropriate behavior, and any other behaviors other than the inappropriate behaviors. Appropriate behaviors included utilizing the iPad via the steps identified on the task analysis. Differential reinforcement procedures were utilized to reinforce appropriate behaviors such as sitting in the chair, utilizing the iPad appropriately, responding to questions asked, and requesting appropriately.

Intervention Steps

The task analysis utilized within this study can be found in Appendix F. This includes the steps that were taught via graduated guidance to teach communication via the iPad.

Step One. Step one involved both the communicative partner (i.e., RBT) and silent prompter (i.e., parent). At the start of each session, a preference assessment was conducted. Then, the communicative partner held an item that the child preferred, while sitting across the table from the child and silent prompter. The iPad was between the communicative partner and

the child on the table. When the child reached for the item, the silent partner prompted the child to pick up the iPad and hand it to the communicative partner, following the graduated guidance described in the prompting hierarchy, staring with a Level 1 prompt. The child then received the desired item and had access to the item for 30 seconds. At this point the iPad screen was black and off.

If the child did not reach for the item or show any response for 10 seconds, the silent prompter initiated a Level 1 hand-over-hand prompt to exchange the iPad. This prompt was then faded according to the prompting hierarchy, in a most-to-least fashion. If incorrect responses occurred (e.g., throwing the iPad, handing it to the wrong person, walking away from the table, etc.) the child was redirected back to the table, and immediately prompted with a Level 1 hand-over-hand prompt. Children were reinforced on a continuous schedule of reinforcement every time they exchange the iPad at the desired step.

Step Two. Step two was completed using the same procedures as step one. In addition to completing the exchange outlined in step one, the children now had to push the home screen to light it up and swipe up to open the iPad before physically exchanging the iPad with the communicative partner. After pressing the home screen and swiping up, the screen opened to Proloquo2Go, in which the screen was blank. If the child reached for the item, or attempted to communicate using step one, the silent partner prompted the child to tap the screen and swipe up, following the graduated guidance described in the prompting hierarchy, staring with a Level 1 prompt. The child then received the desired item and had access to the item for 30 seconds.

If the child did not attempt to communicate or show any response for 10 seconds, the silent prompter initiated a Level 1 prompt. This prompt was then faded according to the prompting hierarchy, in a most-to-least fashion. If incorrect responses occurred (e.g., throwing

the iPad, handing it to the wrong person, walking away from the table, etc.) the child was redirected back to the table, and immediately prompted with a Level 1 hand-over-hand prompt. Children were reinforced on a continuous schedule of reinforcement every time they exchange the iPad at the desired step.

Step Three. Step three was completed the same way as steps one and two. Along with all of the above requirements, participants were required to push a picture of their desired item on the application, after pressing the home screen and swiping up. After pressing the home screen and swiping up, the screen opened up to Proloquo2Go, in which the screen was blank. They then exchanged the iPad. If the child reached for the item, or attempted to communicate using step two, the silent partner prompted the child to tap the screen and swipe up and click the picture of the item following the graduated guidance described in the prompting hierarchy, staring with a Level 1 prompt. The child then received the desired item and had access to the item for 30 seconds.

If the child did not attempt to communicate or show any response for 10 seconds, the silent prompter initiated a Level 1 prompt. This prompt was then faded according to the prompting hierarchy, in a most-to-least fashion. If incorrect responses occurred (e.g., throwing the iPad, handing it to the wrong person, walking away from the table, etc.) the child was redirected back to the table, and immediately prompted with a Level 1 hand-over-hand prompt. Children were reinforced on a continuous schedule of reinforcement every time they exchange the iPad at the desired step.

Step Four. Step four was completed the same way as steps one through three. Along with pressing the home screen and swiping up, the screen opened to Proloquo2Go, in which an "I want" button appeared. They then pressed the "I want" button which opened to a folder

containing one picture of the desired item. They then clicked this picture as well, and exchanged the iPad.

If the child reached for the item, or attempted to communicate using step three, the silent partner prompted the child to tap the screen and swipe up, click the "I want" folder and the item, and exchange following the graduated guidance described in the prompting hierarchy, staring with a Level 1 prompt. The child then received the desired item and had access to the item for 30 seconds.

If the child did not attempt to communicate or show any response for 10 seconds, the silent prompter initiated a Level 1 prompt. This prompt was then faded according to the prompting hierarchy, in a most-to-least fashion. If incorrect responses occurred (e.g., throwing the iPad, handing it to the wrong person, walking away from the table, etc.) the child was redirected back to the table, and immediately prompted with a Level 1 hand-over-hand prompt. Children were reinforced on a continuous schedule of reinforcement every time they exchange the iPad at the desired step

Step Five. Step five was completed the same way as steps one through four. Along with tapping the screen, swiping up, clicking the "I want" button and the item, participants were required to press the sentence strip to make the iPad "speak" the sentence out loud, and then exchange. If the child reached for the item, or attempted to communicate using step four, the silent partner prompted the child to tap the screen and swipe up, click the "I want" folder and the item, click the sentence strip, and exchange following the graduated guidance described in the prompting hierarchy, staring with a Level 1 prompt. The child then received the desired item and had access to the item for 30 seconds.

If the child did not attempt to communicate or show any response for 10 seconds, the silent prompter initiated a Level 1 prompt. This prompt was then faded according to the prompting hierarchy, in a most-to-least fashion. If incorrect responses occurred (e.g., throwing the iPad, handing it to the wrong person, walking away from the table, etc.) the child was redirected back to the table, and immediately prompted with a Level 1 hand-over-hand prompt. Children were reinforced on a continuous schedule of reinforcement every time they exchange the iPad at the desired step

Step Six. Step six would be completed the same way as steps one through five. Along with the above requirements, participants would be required to complete all steps with a novel communicative partner (e.g., parent, sibling) to demonstrate generalization. All criteria following the exchange remain the same. No participants progressed to step six.

Mastery Criteria. Participants remained on the current step of the task analysis until they met the criterion for two consecutive days. Criterion was set at 80% correct responding during their 10-minute training session, across two consecutive sessions. Criterion was set at mastery of each step. They then moved on to the next step. All participants were to begin intervention at the same time; however, scheduling and COVID-related incidences pushed some children farther back on their start date. The intervention continued across all six steps until the intervention period concluded, with each step being a new criterion.

Maintenance Procedures

To ensure that the skill has been learned and maintained once intervention has been concluded, two maintenance probes would have been conducted. No children completed all six steps of intervention; therefore, maintenance probes were not conducted. They all continued the

intervention where they left off with their respective BCBAs, therefore maintenance could not be assessed as they were all in acquisition.

Data Analysis Procedures

Experimental control was demonstrated based on the length of each phase, as well as the level of each change in criterion. All participants did not complete all six steps of the task analysis, but the more changes in criterion that were completed, the more experimental control was demonstrated. Visual analysis was conducted across each participant individually. Due to the nature of the design, effect size will not be calculated.

Question One. During the training phases, the percentage of correct responses during the 10-minute training period was graphed. During the 10-minute training period, all data points were collected. If a child engaged in the correct response for 80% or more of the completed trials, they had one criterion data point at mastery. Two data points with correct responses for 80% or more of the completed trials were required to move onto the next criterion point. Upon completion of the study, visual analysis was completed, including the length of phases, level of each criterion change, and the number of criterion changes (Cooper et al., 1987).

Question Two. A frequency count of gestures was kept during baseline as well as during intervention. This frequency count will be displayed graphically, and visual analysis will take place in order to see if an increase or decrease occurs in the number of gestures used to communicate.

Question Three. Social validity questionnaires will be sent to parents of all participants as well as each RBT involved. This data will then be compiled and presented to show if the intervention was socially valid.

To ensure replication is possible, procedures have been written out in detail, data sheets, task analysis, and social validity checklist have also been provided to aid in easy and efficient replication. This will also increase fidelity of the procedures and decrease error, as well as assisting in the teacher training aspect of this research.

Chapter Four: Results

Children with ASD often use alternative forms of communication (e.g., PECS, SGDs, gesturing) to express their wants and needs. Although standardized measures exist for implementing the PECS protocol, no such measures exist for many SGDs (Bondy & Frost, 1994; Lorah et al., 2018). The Apple iPad presents many opportunities for alternative communication, specifically through the application Proloquo2Go (Lorah & Parnell, 2017; Lorah, 2018) This application can be programmed to contain pictures, words, typing, sounds, and is completely customizable to the child using it (AssistiveWare, 2019).

Proloquo2Go is becoming commonly used with children with ASD that may struggle with vocal speech (Lorah, 2018). However, it is introduced to children in several different ways, often recreating procedures for PECS on the iPad and merely using it as an electronic picture. This can discount the need to teach the child how to navigate the iPad and to begin to use the application functionally.

The purpose of this study was to discover if graduated guidance was (a) successful in teaching a forward chained task analysis via the iPad to increase communicative attempts in children with ASD and (b) if this task analysis on the iPad was subsequently used more frequently than gesturing. The research questions to be examined were:

1. Is graduated guidance effective in teaching a forward chained task analysis on the iPad, and effective at increasing communicative attempts in children with ASD?
2. Does student implementation of the steps of the task analysis used in this study result in more frequent use of the iPad when compared to gesturing to communicate wants and needs?

3. Do the parents and RBT's think that the iPad-based graduated guidance intervention is effective at increasing communicative exchanges in students with ASD?

This next chapter will report on all data collected during baseline and intervention phases. Data will be broken down by each participant involved in the intervention.

Data Analysis

All children involved in the intervention were chosen from a private ABA-based clinic in the southwestern United States. Following consent from parents, Board Certified Behavior Analysts (BCBAs) that worked closely with each child reviewed the inclusion and exclusion criteria. Children were then selected by the BCBA and the information was provided to the researcher to complete all consent forms. Four children met criterion and completed the intervention.

Research Question One

The first research question asked: Is graduated guidance effective in teaching a forward chained task analysis on the iPad and effective at increasing communicative attempts in children with ASD? Figure 1 displays graphs for each child in baseline and intervention phases, including all steps that were completed by each participant. Figure 2 displays all raw scores graphically with lines delineating the phase changes. All participants stayed in baseline for five days, with intervention starting immediately after the fifth session (What Works Clearinghouse, 2013). The start date of the intervention varied slightly between each participant due to the availability of the in-home Registered Behavior Technician (RBT) as well as the parent. All participants began intervention on Step 1 of the task analysis (see Appendix F). The RBT acted as the communicative partner for each of the participants, while the parent acted as the silent prompter.

All training sessions for both the parents and the RBTs took place online, which limited the amount of feedback and interaction that took place between the researcher and those implementing the intervention. Sessions were recorded and uploaded for the researcher to give feedback; however, videos were not always uploaded in a timely manner, or did not show the entirety of the environment the child was in. Feedback was provided related to how the intervention was conducted throughout the entirety of the research project, however it was not always timely due to technical difficulties with uploading videos.

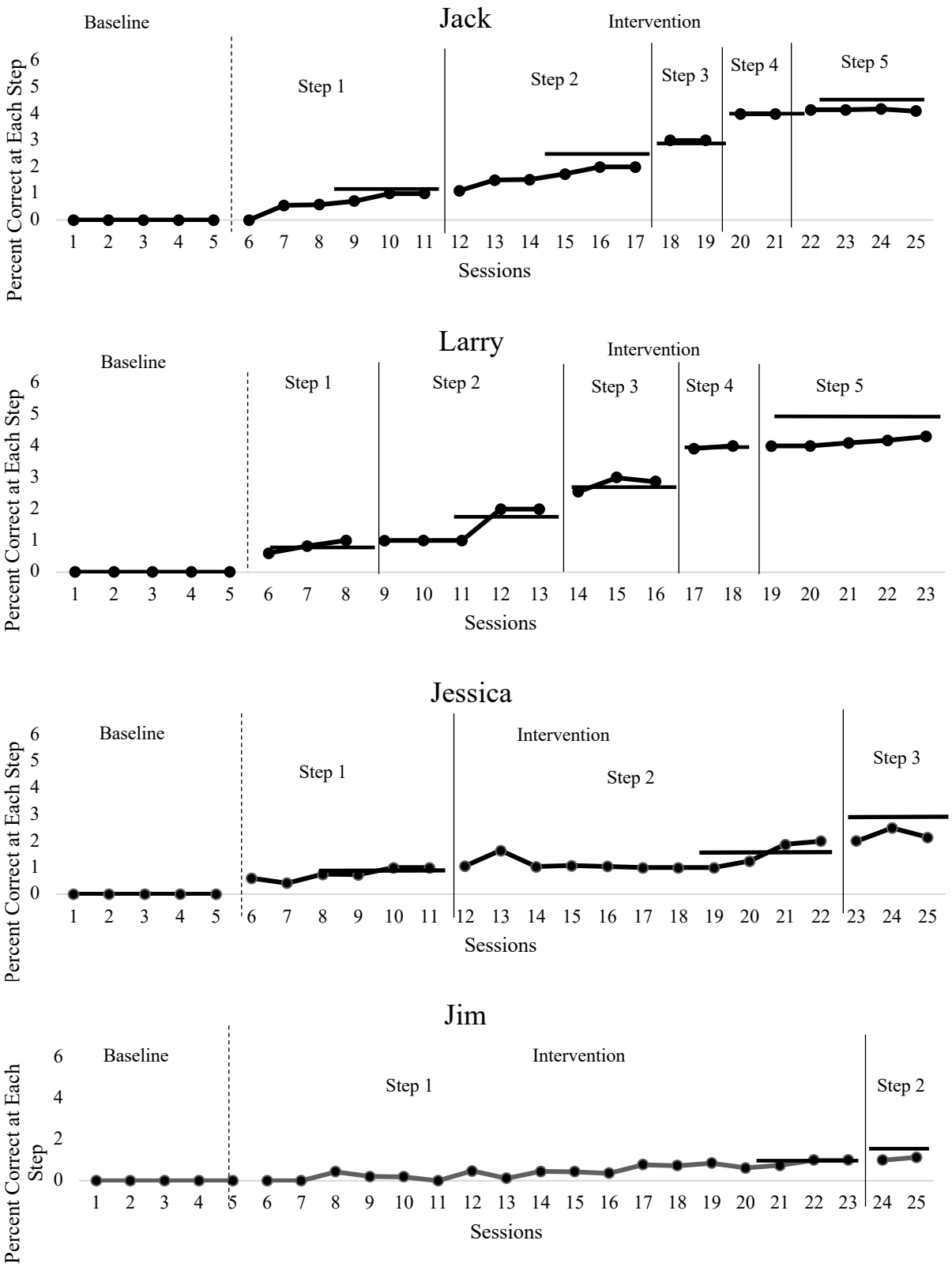

Figure 1. Data for all baseline and intervention steps on each step of the task analysis with steps as the y-axis

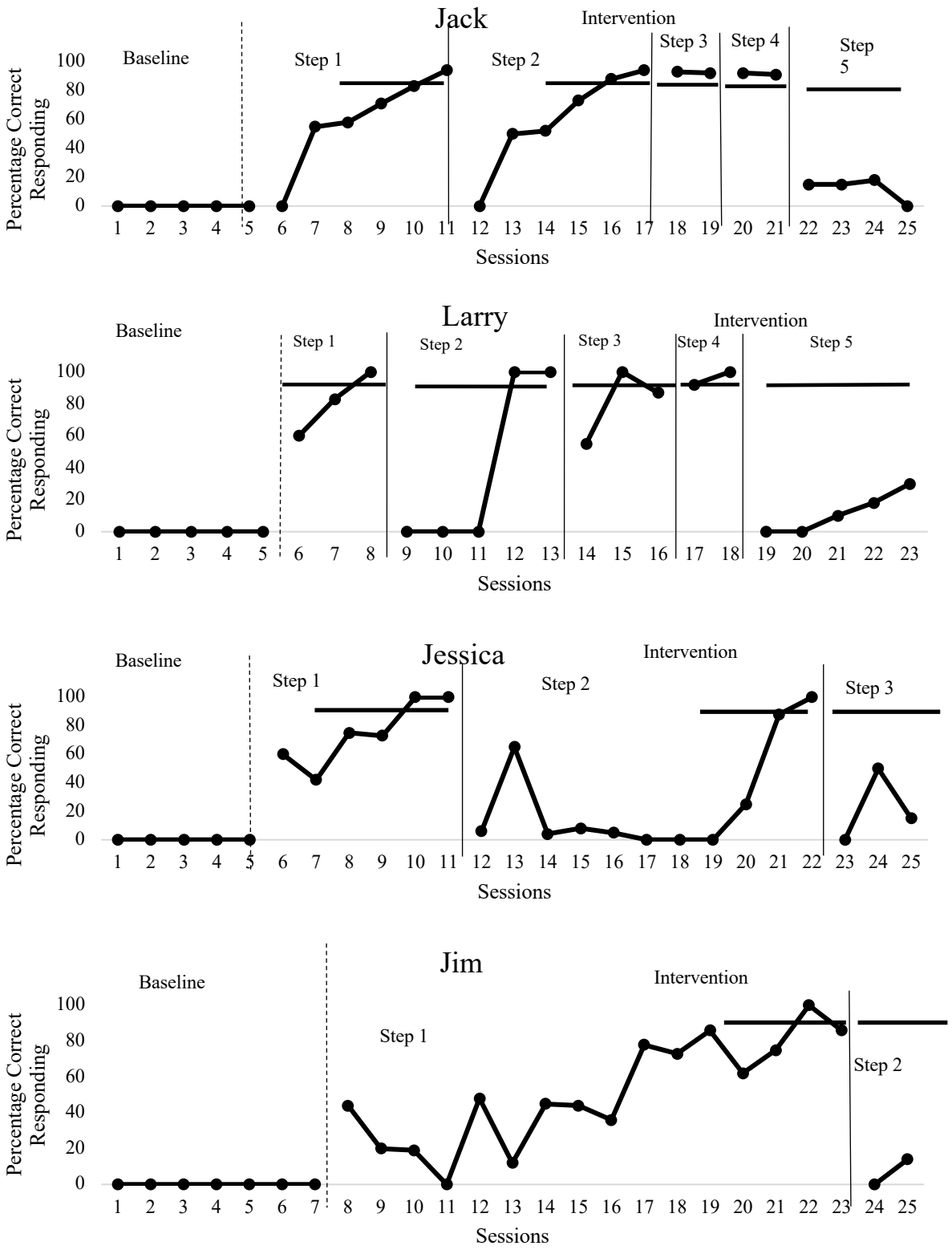

Figure 2. Data for all baseline and intervention steps on each step of the task analysis percent correct as the y-axis

Jack

Jack had a mean of 0% correct responding on the steps of the task analysis during baseline. Following a preference assessment, the iPad was placed on the table in front of Jack, with the communicative partner sitting across from him, who held the desired item previously chosen during the preference assessment. Jack was disinterested in the chosen item during baseline, and engaged in self-stimulatory behaviors (e.g., vocalizations, finger manipulations) throughout most baseline sessions.

Of the six steps on the task analysis, Jack met criterion on four of them within the given 20 sessions. Criterion at any step was set at: 80% of responses within the 10-minute session being marked as correct (i.e., responding on the correct step). Jack met criterion of the first step on the task analysis after six days of intervention. He met criterion with 83% and 94% correct responding within the 10 minutes. One RBT worked with Jack throughout the entirety of the research. The prompting hierarchy (located in Appendix J) was utilized by Jack's grandpa and mother to teach each step via graduated guidance. Following completion of all levels of prompting, Jack would not independently respond, and the hierarchy was restarted.

Jack demonstrated difficulty understanding the exchange of the iPad. Immediate contingent reinforcement was used to strengthen the temporal contiguity of the exchange and subsequent receipt of the reinforcing item (Cooper et al., 1987). Once Jack understood that exchanging the iPad resulted in earning desired items, he progressed quickly through the next steps in the task analysis. Jack reached criterion of step two (e.g., tapping the screen and swiping before exchanging) after six days of intervention. He met criterion at 88% and 94% correct responding within the 10 minutes. Accessibility options within the Proloquo2Go application

were used to accept a light touch to turn on the iPad. Jack often reverted to exchanging the iPad without tapping the screen and swiping up, slowing down his acquisition rate.

Jack met criterion for step three (i.e., turning on the iPad and swiping, clicking the icon on the screen of the desired item, and exchanging the iPad) after only two days. He met criterion at 93% and 94% correct responding within the 10 minutes. Only one prompt on the hierarchy (i.e., prompt level 1) was required before he began responding independently. Pictures were changed each day based on what Jack showed preference for in his preference assessment.

Jack met criterion for step four (i.e., turning on the iPad and swiping up, clicking the "I Want" folder and the icon, exchanging the iPad) after four days of intervention. He met criterion at 92% and 91% correct responding within the 10 minutes. As he was now required to click the screen two times, the hierarchy was used multiple times to prompt him not to exchange the iPad after only one time touching the screen. He began step five (i.e., turning on the iPad and swiping up, clicking the I Want folder and the icon, clicking the sentence strip, exchanging the iPad) but did not meet criterion before the 20 intervention sessions ended. Overall, Jack had a mean of 0% correct responses throughout baseline, and a mean of 56% correct responses throughout the entirety of the intervention sessions.

Visual analysis was conducted across Jack's changing criterion graph. Although it is recommended to have subjects stay at the phases for different lengths of time for experimental control, a set number was used since the researcher was not implementing the steps of the intervention (Cooper et al., 1987). Allowing the RBTs to decide when to change to the next criterion would have allowed too much subjectivity. This is also consistent with past changing criterion graphs and research on PECS (Beck et al., 2008; Dogoe et al., 2010;Ganz et al., 2005; Ganz & Simspon, 2004; Lorah, 2018; Lorah et al., 2014; Marckel et al., 2006; Shrestha et al.,

2013; Yokoyama et al., 2006). Jack stayed at each criterion point for two consecutive data points before moving up to the next criterion. Jack demonstrated a stable trend at baseline, with 0% correct responding. The level change between baseline to step one were slight, as well as between step one and step two. However, between steps two and three, a large level change was observed. Steps three to four and four to five also had a small change in level. This is acceptable and still demonstrates a functional relation due to the stable level of response as well as the number of criterion changes Jack exhibited (Cooper et al., 1987). Jack met three criterion changes, increasing the strength of the functional relation. Jack's descriptive statistics can be found in Table 8, showing the range of trials ran for each step, the mean number of trials within each step, and the standard deviation within each step.

Table 8

Descriptive statistics for each trial ran for Jack

	Range of number of trials ran	Mean number of trials ran	SD of all trials
Step 1	6-20	15.3	5.23
Step 2	14-17	15.8	1.17
Step 3	14-15	14.5	.71
Step 4	12-13	12.5	.71
Step 5	11-13	12.25	.96

Larry

Larry had a mean of 0% correct responses during baseline. Following a preference assessment, the iPad was placed on the table in front of Larry, with the communicative partner sitting across from him, holding the desired items previously chosen during the preference assessment. Larry was highly motivated to earn various items throughout baseline as well as intervention.

Of the six steps on the task analysis, Larry met criterion on four of them within the 18 intervention sessions completed. Criterion at any step was set at: 80% of responses within the 10-minute session being marked as correct (e.g., responding on the correct step). One RBT remained working with Larry throughout the entirety of the research study and acted as the communicative partner. They held the desired item while sitting across from the table from Larry. Larry's mom acted as the silent prompter throughout the entirety of the research study.

Larry met the criterion for step one (i.e., exchanging the iPad) after three days of intervention. He met criterion at 83% and 100% correct responding within the 10 minutes. He consistently chose the same reinforcers within preference assessments and was highly motivated to earn them. Once the prompting hierarchy was completed one time, Larry responded independently on step one.

Larry met criterion for step two (i.e., tapping the screen and swiping before exchanging) after five days of intervention. He met criterion at 100% correct responding within the 10 minutes across both days. Larry demonstrated difficulty swiping up on the screen at the correct location. Accessibility options to accept a light touch were also used for Larry. Level 1 prompts were used often to demonstrate where Larry should start and end swiping. Once Larry understood how to swipe, the prompting hierarchy was no longer needed to complete the step.

Larry met criterion for step three (i.e., turning on the iPad and swiping, clicking the icon on the screen of the desired item and exchanging the iPad) after three days of intervention. He met criterion at 100% and 87% correct responding within the 10 minutes. Pictures of desired items were changed on the Proloquo2Go application based on what Larry chose during his preference assessments.

Larry met criterion for step four (i.e., turning on the iPad and swiping up, clicking the "I Want" folder and the icon and exchanging the iPad) after only two days of intervention. He met criterion at 92% and 100%. Step five (i.e., turning on the iPad and swiping up, clicking the I Want folder and the icon, clicking the sentence strip, and exchanging the iPad) was introduced but was not met before intervention concluded. The RBT ended intervention two days early for unknown reasons, so it is unclear whether Larry would have met criterion within those next two days. The RBT miscalculated her days and thought she had completed 20 sessions. However, when data were given to the researcher, they were two days short. Overall, Larry had a mean of 0% correct responding during baseline, and a mean of 52% correct responding during intervention.

Visual analysis was conducted across Larry's changing criterion graph. Larry also only remained at criterion for two data points to limit potential subjectivity related to RBT decisions about the length of each criterion. Larry had a stable trend in baseline, with 0% correct responding. He had a somewhat large level change between baseline and step one as he learned to exchange the iPad. Between steps one and two, the change in level was slight, as he took more time learning how to swipe on the iPad. The level changes between steps two and three, and three and four were much larger, as he met criterion almost immediately within those steps. When step five was introduced, the level change was slight, and he never met criterion within

intervention. Larry demonstrated three criterion changes, strengthening the functional relationship between the intervention and the behavior change. Larry's descriptive statistics can be found in Table 9, showing the range of trials ran for each step, the mean number of trials within each step, and the standard deviation within each step.

Table 9

Descriptive statistics for each trial ran for Larry

	Range of number of trials ran	Mean number of trials ran	SD of all trials
Step 1	10-13	11.6	1.53
Step 2	10-13	11.8	1.1
Step 3	11-15	12.3	2.31
Step 4	11-12	11.5	.71
Step 5	10-15	11.4	2.07

Jessica

Jessica had a mean of 0% correct responding during baseline. Following a preference assessment, the iPad was placed on the table in front of Jessica, with the communicative partner sitting across from her, holding the desired items previously chosen during the preference assessment. Jessica was highly motivated to earn various items throughout baseline as well as intervention.

Of the six steps on the task analysis, Jessica met criterion on two of them within the 20 intervention sessions completed. Criterion at any step was set at: 80% of responses within the 10-minute session being marked as correct (i.e., responding on the correct step). One RBT remained working with Jessica throughout the entirety of the research study and acted as the communicative partner. They held the desired item while sitting across the table from Jessica. Jessica's mom acted as the silent prompter throughout the entirety of the research study.

Jessica met the criterion for step one (i.e., exchanging the iPad) after six days of intervention. She met criterion at 100% correct responding within the 10 minutes for both days. The prompting hierarchy was used multiple times throughout each teaching session, as Jessica would often attempt to grab the items from the RBT rather than exchange the iPad. She was highly motivated to earn a host of different items throughout intervention.

Jessica met criterion for step two (i.e., tapping the screen and swiping before exchanging) after 11 days of intervention. She met criterion at 88% and 100% correct responding within the 10 minutes. Jessica demonstrated great difficulty with tapping the screen. She demonstrated the ability to swipe once the screen was lit up, but even with accessibility options for a light touch, each time she tapped the iPad, the screen would not light up due to her light touch. The prompting hierarchy was used many times throughout each teaching session to encourage her to put more pressure on the iPad screen to turn it on. iPad Airs have no home button, making it a requirement for children to be able to tap the screen to turn it on and access it. This took much of her intervention time.

Step three (i.e., turning on the iPad and swiping, clicking the icon on the screen of the desired item and exchanging the iPad) was introduced but Jessica did not meet criterion before intervention ended. Since this step also involved tapping the screen, she demonstrated some

difficulty tapping the button with enough pressure. Overall, Jessica had a mean of 0% correct responding during baseline, and a mean of 41% correct responding during intervention.

Visual analysis was conducted across Jessica's changing criterion graph. Jessica also only remained at criterion for two data points to limit subjectivity related to individualized RBT decision-making. Jessica had a stable trend during baseline with 0% correct responding. She had a somewhat large level change between baseline and step one as she learned to exchange the iPad relatively quickly. However, due to the difficulties with Jessica lighting up the screen, her level change between step one and step two is barely noticeable. The same can be said for step three. The level change is slight. Step three was introduced but not completed within the intervention time. Jessica demonstrated one change in criterion between step one and step two. Jessica's descriptive statistics can be found in Table 10, showing the range of trials ran for each step, the mean number of trials within each step, and the standard deviation within each step.

Table 10

Descriptive statistics for each trial ran for Jessica

	Range of number of trials ran	Mean number of trials ran	SD of all trials
Step 1	10-18	13.5	2.81
Step 2	12-23	15.2	3.33
Step 3	11-14	16.7	1.53

Jim

Jim had a mean of 0% correct responding within baseline. Following a preference assessment, the iPad was placed on the table in front of Jim, with the communicative partner sitting across from him, holding the desired items previously chosen during the preference assessment. Jim was not highly motivated to earn the items the RBT presented during the preference assessments. The same items were presented often, and Jim was satiated with the items before intervention had begun each day.

Of the six steps on the task analysis, Jim met criterion on one of them within the 20 intervention sessions completed. Criterion at any step was set at: 80% of responses within the 10-minute session being marked as correct (i.e., responding on the correct step). Jim had two RBTs that worked with him throughout the intervention. Unfortunately, Jim's intervention sessions were inconsistent. The first RBT was out due to medical necessity twice during intervention, causing gaps in teaching times. Intervention was also not completed for one week due to an illness with Jim. Once a new RBT was placed on the team, Jim had consistent intervention sessions. Jim's mom acted as the silent prompter throughout the entirety of the research study.

Jim met the criterion for step one (i.e., exchanging, the iPad) after 18 days of intervention. He met criterion at 100% and 86% correct responding within the 10 minutes. Of the 10 days he had with the consistent RBT, he met criterion in eight intervention days. Step two was introduced but criterion was not met before the intervention ended. Jim engaged in protest behavior (e.g., crying, attempting to elope, swiping items) throughout many of the intervention sessions. Once the contingency was understood that exchanging the iPad resulted in a desired item, Jim responded correctly at a much higher frequency. Overall, Jim had a mean of 0% correct responding during baseline, and a mean of 42% correct responding during intervention.

Visual analysis was conducted across Jim's changing criterion graph. Jim also only remained at criterion for two data points to limit interventionist subjectivity. Jim had a stable trend in baseline with 0% correct responding. Jim had no noticeable level changes between phases. Due to the length of time Jim spent learning step one, he only met criterion for step one, and did not complete any criterion changes. Step two was introduced before intervention ended, but there was not a large level change between step one and step two. Jim's descriptive statistics can be found in Table 11, showing the range of trials ran for each step, the mean number of trials within each step, and the standard deviation within each step.

Table 11

Descriptive statistics around each trial ran for Jim

	Range of number of trials ran	Mean number of trials ran	SD of all trials
Step 1	9-23	13.1	5.4
Step 2	6-7	6.5	.71

Research Question Two

Question two asked: Does student implementation of the steps of the task analysis used in this study result in more frequent use of the iPad when compared to gesturing to communicate wants and needs? Data on gestures were taken throughout all baseline and intervention sessions.

Gestures were counted any time the participant pointed or reached toward the desired item. Figure 3 shows all gesture data during baseline and intervention for all participants.

Jack

Jack engaged in a mean of 5.6 gestures per 10-minute session during baseline. Once intervention began, Jack's gestures rapidly decreased. Throughout the 20 intervention sessions, he averaged 1.2 gestures throughout each 10-minute intervention period. His level change was not immediate between baseline and intervention (i.e., last baseline data point was 6 gestures, first intervention data point was 6 gestures). However, his downward trend showed a great decrease in the number of gestures he was using to get his wants and needs met.

Larry

Larry engaged in a mean of 14.8 gestures per the 10-minute session during baseline. Once intervention began, Larry's gesture use decreased, but he continued to engage in gestures throughout many teaching sessions. He averaged 4 gestures per each 10-minute training session. Gestures tended to only occur at the beginning of the teaching period but did not dissipate throughout intervention. A large change in level was demonstrated between baseline and intervention (i.e., last baseline data point was 9 gestures, first intervention data point was 4 gestures). Larry's gesture use continued to decline, but increased after his 8th training session (i.e., 11 gestures). This may be due to a difficult step on the task analysis, in which perhaps Larry was not getting his wants and needs met on the current step, so he reverted back to using gestures.

Jessica

Jessica engaged in a mean of 10.4 gestures during each 10-minute session during baseline. Once intervention began, Jessica's gesturing decreased significantly. She engaged in an

average of 1.5 gestures throughout each 10-minute intervention period. She had a large change in level between baseline and intervention (i.e., last baseline data point was 16 gestures, first intervention data point was 3 gestures). Her data were somewhat variable, but eventually continued a downward trend throughout the remainder of intervention.

Jim

Jim engaged in a mean of 14.6 gestures per each 10-minute session during baseline. Once intervention began, Jim's gestures did not significantly decrease until the second RBT began implementing intervention, due to previous inconsistencies with implementation. He averaged 3.05 gestures during each 10-minute intervention period. He had a large change in level between baseline and intervention (i.e., last baseline data point was 17 gestures, first intervention data point was 5 gestures); however, the next day he engaged in 18 gestures. He had an overall downward trend, showing that he did have a decrease in gesturing to get his wants and needs met.

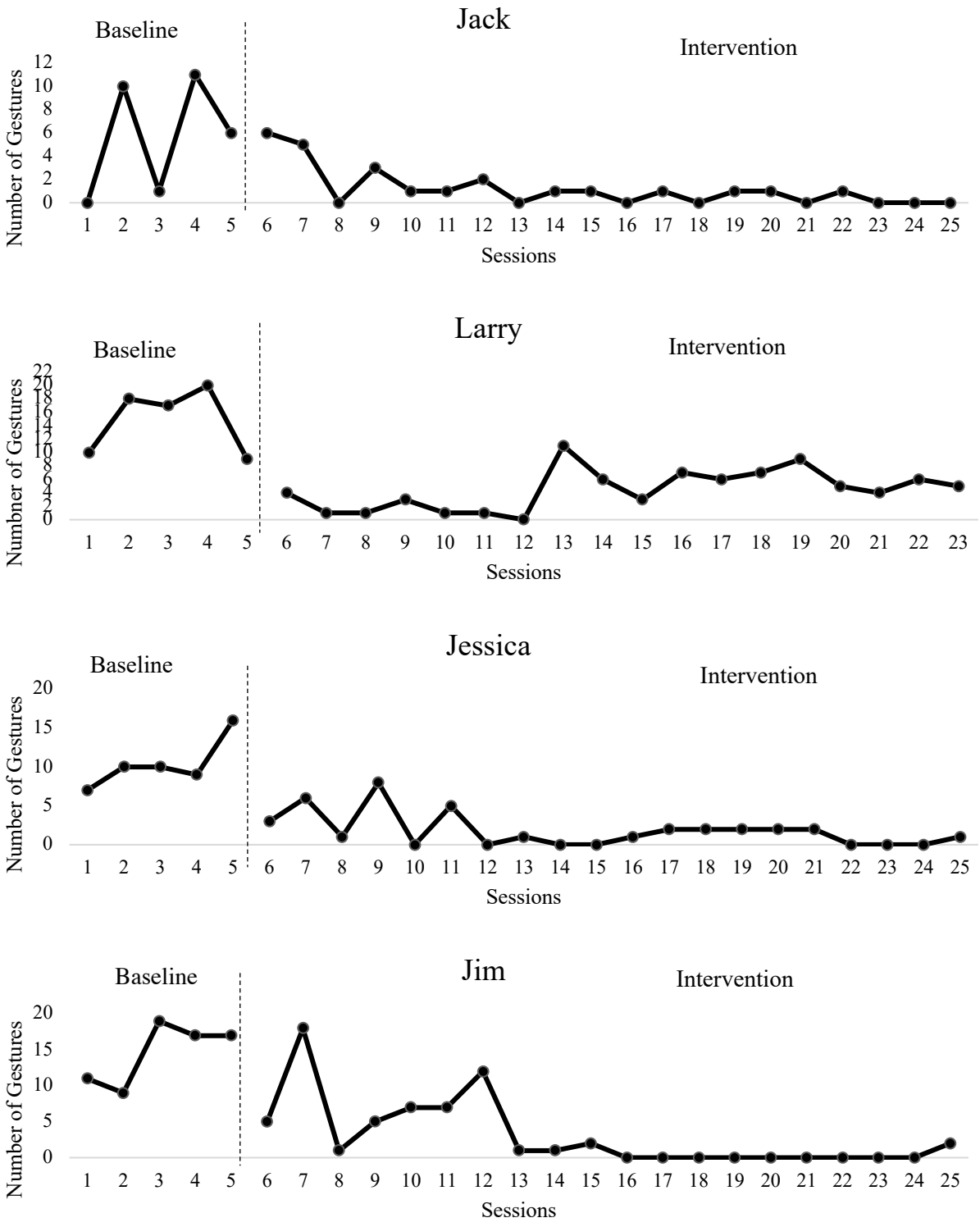

Figure 3. Data for all gesture use during baseline and intervention

Research Question Three

Research question three asked: Do the parents and RBTs think that the iPad-based graduated guidance intervention is effective at increasing communicative exchanges in students with ASD? Social validity questionnaires were given to both the RBTs and the parents. No formal social validity measures were taken with the children due to the lack of receptive and expressive language they possessed. RBT social validity forms included questions on ease of use, ease of implementation, the usefulness of the intervention, and whether the client preferred to use the iPad or gestures. Table 12 shows all questions and responses recorded from each RBT.

Table 12

Social validity questions and responses for RBTs

	RBT For			
Social Validity Questions	Jack	Larry	Jessica	Jim
I found this intervention easy to learn:	Yes	Yes	Yes	Yes
I found this intervention helpful in therapy sessions:	Yes	Yes	Yes	No
I found this intervention helpful to my client:	Yes	Yes	Yes	Yes
I understand why this intervention was implemented:	Yes	Yes	Yes	Yes
I understand how to implement this intervention:	Yes	Yes	Yes	Yes
I will implement this intervention with future clients:	Yes	Yes	Yes	Yes
Graduated guidance was effective at teaching this intervention:	Yes	Yes	Yes	Yes
Forward chaining was effective in teaching this intervention:	Yes	Yes	Yes	Yes
The skills taught to my clients were useful or useless:	Useful	Useful	Useful	Useful
Utilizing the iPad was more or less stigmatizing than other communication devices:	Less	Less	Less	Less

My client prefers the iPad or gestures more:	iPad	iPad	iPad	iPad

All RBTs agreed that the intervention was easy to learn, the intervention was helpful to the client, graduated guidance was effective at teaching this intervention, and that forward chaining was effective at teaching this intervention. The RBT working with Jim did not agree that this intervention was helpful in therapy sessions, most likely due to the high rate of protest behavior Jim engaged in during intervention. All RBTs also understood why this intervention was implemented, how to implement it, and agreed that they would implement this in the future with other clients. They also stated that the skills were useful, the iPad was less stigmatizing than other communication devices, and that the client they worked with preferred using the iPad over using gestures.

Three open-ended questions were asked to allow for additional feedback. These questions were: What I liked about the intervention, what I did not like about the intervention, what I would change about the intervention. RBTs responses varied for each question. See responses below in Table 13.

Table 13

Social validity open ended questions and responses for RBTs

Question	Responses
What I liked about the intervention:	1. Providing a practical means of communication for the client 2. Watching the client progress through a new form of communication 3. Teaching a more functional form of communication

	4. Varying reinforcement 5. Easy to use and teach
What I did not like about the intervention:	1. Relies on the client's appetite which is sometimes not there 2. Client was not interested in tangible items 3. Nothing
What I would change about the intervention:	1. Incorporate another reinforcer not reliant on appetite 2. Be mindful of clients that do not prefer tangible items 3. Nothing

Parents agreed that their child utilized the iPad to request at home, that they understand how to assist their child with using the iPad, and that they will continue to utilize the iPad in the home. All four parents stated that their child preferred to communicate via the iPad, and that they communicated more following the intervention.

Although no formal social validity measures were conducted with the participants, the researcher noted that when the iPad was presented, each participant gravitated toward the device. Also, the decrease in gesture use may show a preference for the iPad over other forms of communication.

Interobserver Agreement

Data were taken on all recorded videos by the researcher on both the procedural fidelity checklist as well as discrete trial data. Discrete trial data were taken by each individual RBT on each team. A doctoral student with 4 years of graduate research that holds the BCBA credential took data on 31% of recorded sessions that were selected randomly. IOA total was 95% agreement on the procedural fidelity checklist. A total procedural fidelity score for each RBT across all sessions can be found below in Table 14.

Table 14

Procedural fidelity for each subject across all sessions

Subject	Overall Procedural Fidelity Score
Jack	99%
Larry	91%
Jessica	99%
Jim	89%

The researcher acted as the interobserver for the discrete trial data. Individual scores for each RBT can be found in Table 15. The researcher took data on every session, totaling 100% of sessions. Scores were not consistent with each RBT, however no notifiable differences occurred. The researcher did not total any score above 80% when the RBT did not, which means the changes in criterion were consistent (i.e., the researcher and the RBT never disagreed on a score that would have changed the outcome of the intervention). Scores were typically off between 5 and 10 percent per session day. This may be due to the camera angle that the researcher was seeing or the RBT not being clear on the response criterion. 80% criterion is expected in order to ensure fidelity, and therefore a discussion on how discrete trial data were taken must occur (Kratochwill et al., 2010).

Table 15

Interobserver scores of procedural fidelity and discrete trial data

Subject	IOA of Procedural Fidelity	IOA of Discrete Trial Data
Jack	100%	80%

Larry	100%	83%
Jessica	100%	75%
Jim	80%	60%

Chapter Five: Discussion

The purpose of this dissertation was to determine if graduated guidance was effective in teaching a forward chained task analysis to increase communicative attempts for non-verbal children with Autism Spectrum Disorder (ASD). A single case design that most closely aligns with changing criterion was used in order to implement the intervention. All intervention sessions took place in the home with the parent, Registered Behavior Technician (RBT), and young children aged two to five years old.

Two out of the four participants mastered four of the six steps on the task analysis, which meant they were exchanging the iPad after clicking "I want" and a picture of the preferred item, one participant mastered step two, meaning they ended after tapping the screen and swiping up to open the iPad, and one only mastered the first step, meaning they ended after exchanging the iPad for the desired item. Gesture use reduced in all participants; however, they did not fully dissipate by the end of the intervention. Social validity questionnaires showed that both RBTs and parents found that graduated guidance was an effective intervention in teaching communication on the iPad. Parents and RBTs also found that the participants utilized the iPad to communicate more and agreed that using the iPad for communication was effective.

Training of the parent and RBT on all facets of the intervention took place over Zoom due to COVID-19 restrictions. All children were currently receiving in person services, and therefore the RBTs were not additional personnel in the home. The researcher was not allowed to enter the children's homes, so all feedback and communication took place virtually. During virtual trainings, preference assessments, differential reinforcement, prompting hierarchies, data taking, and procedural fidelity were all demonstrated to both the parent and RBT. Baseline took place for 10-minutes a session across five sessions for each participant. The intervention took

place for 10-minutes a session, across 20 sessions for each participant. The discussion that follows addresses all findings from the research.

Teaching Students with ASD to Increase Communication Attempts with an iPad

The main goal of this dissertation was to find if graduated guidance was effective in teaching a forward chained task analysis on the iPad. A design that most closely aligns with changing criterion was implemented due to the nature of a forward chain (Cooper et al., 1987; Klein et al., 2017). Two out of four participants demonstrated more than two criterion changes, suggesting a functional relationship between the intervention and the change in behavior (Cooper et al., 1987; Klein et al., 2017). The other two participants demonstrated one criterion change, and none, respectively. Although these are not enough criterion changes to demonstrate a functional relationship, both participants began utilizing the iPad to communicate prior to the conclusion of the intervention.

Both Jack and Larry progressed to step five of the task analysis, suggesting that perhaps with more intervention time, they could have completed all six steps of the task analysis. Both participants demonstrated difficulty swiping on the iPad to open it. Unfortunately, all new models of the Apple iPad are made without a home button, making this an eventuality for many individuals with poor or diminished fine motor control.

Jessica completed two criterion changes within the intervention period. She demonstrated extreme difficulty with turning on the iPad with just a tap. The prompting hierarchy was used almost entirely during multiple training sessions to encourage Jessica to tap the iPad with a firmer touch. This inhibited the amount of time Jessica had to progress through the steps. Once Jessica mastered turning on the iPad, she progressed to the next step almost instantly, suggesting that she may have continued to learn the following steps with a high acquisition rate.

Jim met mastery of only one criterion within the intervention period. Jim was the only participant to have multiple RBTs working with him in the home and was also the only participant to have an RBT miss session time. Once a second RBT was placed on the team with Jim, he no longer had any gaps in intervention. He mastered the first criterion after eight intervention sessions with the new RBT. Jim was also not given varied reinforcement until the second RBT joined the team. Once new reinforcing items were presented and available, Jim's performance drastically increased. This demonstrates the powerful nature of establishing operations and shows the need for varied reinforcement when teaching communication training to individual with ASD (Cooper et al., 1987). It is difficult to determine whether Jim would have made progress with consistent teaching; however, it should be noted that he was the only participant with inconsistent teaching.

All children made gains in learning how to communicate which is consistent with previous research (Lorah et al., 2015; Walker et al., 2018). The research body currently does not have a standardized set of steps to implement communication training via Proloquo2Go on the iPad yet there is a standardized set of steps for PECS (Boyd et al., 2015; Lorah et al., 2018). The school district where this research was conducted requires PECS as a prerequisite to using the iPad without research to assert this as evidence.

Challenges with the iPad

Although the iPad is widely used in research with children with ASD (Gevarter et al., 2014; Lorah et al., 2015; Schlosser & Koul, 2015), there were unforeseen difficulties with using this device. Boyd et al. (2015) discussed the use of the iPad as an advantage over the iPod, due to the larger screen and ability to easily click icons that were of a great size. However, Apple iPads are constantly changing and evolving with their software and their outward appearance. Past

research was conducted on screens that had a home button. This presented some issues for children with ASD as the pressing of the button required a firm touch (Lorah et al., 2015). However, current iPads have no home button and require that individuals tap the screen to turn it on. This also requires a firm touch and is more abstract that a concrete home button that one can see. The placement of where an individual should touch the home screen is subjective, which made it difficult for Jennifer, Jack, and Larry to efficiently turn on the iPad.

Like past research, learning the technology of the iPad (e.g., turning on the iPad, navigating the home screen) slows acquisition more than learning the use of the device (Agius & Vance, 2016; Couper et al., 2014; Hill & Flores, 2014; King et al., 2014). This makes learning the technology an important variable to teach children to ensure that they can communicate via the iPad whether it is turned on or off. For communication to truly be volitional, children should not have to wait for another individual to turn the iPad on for them. Accessibility options on the iPad can be utilized to make turning on the iPad more successful for children with poor fine motor control.

Gesture Use in Children with ASD

The second research question focused on whether the iPad would be used for more communicative attempts than gestures throughout intervention. All four participants demonstrated a decrease in gesture use from baseline to intervention. Participants engaged in an average of 11.35 gestures per 10-minute baseline session, and an average of 1.7 gestures throughout the 10-minute intervention period. Consistent with previous research, all children engaged in gestures to gain access to preferred items (Sowden et al, 2008).

Larry demonstrated a decrease in gesture use, but still utilized gestures in almost all intervention sessions. Larry had a long history of pointing to get his wants and needs met, so

reverted to pointing even when the iPad was present. As gesturing is effective when the item is present, this skill is highly reinforced within a contrived environment where reinforcers are out and available. However, since Larry progressed through step four on the task analysis, he can now start using the iPad to communicate for items that are not in his immediate environment, which may expand his mand repertoire (Xin & Leonard, 2015).

Jessica experienced a sharp decrease in gesture use within intervention. She preferred to exchange the iPad, as it was clear that she was communicating, and she received reinforcement immediately. Jack also demonstrated a decrease in gesture use, but never fully stopped gesturing throughout intervention. Like Larry, it seemed that when any step on the task analysis presented difficulty, Jack would revert to his previous form of communication. This shows how important consistency is when teaching an alternative form of communication. Parents acting as silent prompters and being involved in the intervention will help to ensure that generalization and maintenance occur, which has been reported as a need in SGD use for children with ASD (Lorah et al., 2015). As reported on their social validity form, parents feel that this intervention was important, and they will continue to use this within the home environment.

Jim engaged in a high frequency of gesture use during baseline, and his gesture use did not decrease until the second RBT joined the case. It is difficult to tell if this was due to the inconsistency of teaching, or due to the reinforcement being used. Jim eventually engaged in zero instances of gesturing throughout intervention and remained at a low instance of gesturing throughout the intervention.

Overall, gesture use decreased while all children progressed through steps using the iPad. Some gesture use still occurred throughout intervention, but it was no longer the participant's primary means of communication. Ag gestures in children with ASD appear at a typical rate, yet

stay around much longer, this intervention may help stop the trajectory of children with ASD using only gestures to communicate their wants and needs (Braddock et al., 1997).

Social Importance of the Intervention

All parents and RBTs involved in the intervention completed social validity questionnaires. All parents and RBTs agreed that this intervention was useful and led to significant behavior change in the form of more communication and more functional communication. RBTs are trained in the principles and sciences of ABA, and therefore may understand the concepts involved in this intervention more than classroom teachers and parents outside of this population.

RBTs agreed that graduated guidance was helpful in teaching this intervention, as well as conducting it in a forward chain. They also agreed that they understood why this was implemented and how to implement it in the future. All four RBTs also stated that they enjoyed seeing their clients learn a more functional form of communication. As Boyd et al. (2015) pointed out, it is important that an effective intervention is created for implementing iPad use for individuals with ASD.

Two RBTs wrote about the tangible nature of the intervention, which is an issue with all functional communication training. To have temporal contiguity between the exchange of the iPad and the presentation of the item, tangible items are the easiest to use (Cooper et al., 1987). They are also easily represented by a picture. Future research should explore children that are reinforced by physical items (e.g., squeezes, tickles) and whether they are less likely to respond to this type of communication training, as it is not match-to-sample with the picture and the actual item. It is encouraging that two RBTs also wrote that they found more reinforcers for their client and were forced to be creative with reinforcement sampling. Ensuring that children are

earning preferred items not only guarantees more responses but allows the child more choice in their environment. Past research has found that parental and professional attitudes toward iPad use were positive, and in favor of using the device (Clark et al., 2015). Past circumstances of anxiety related to technology use were reported, however none were reported for this intervention.

Parents found this intervention useful and agreed that their child was using the iPad to communicate more frequently than before. As with past research, parents found the technology used as favorable, and stated that they would continue to use the iPad with their child in the future (Clark et al., 2015). Parents also stated that their child was using the iPad more than gestures to communicate their wants and needs, and that they preferred that their children were able to communicate what they wanted rather than only point at items.

Limitations

Several limitations exist. First, the small number of participants means that the results may not be generalizable to a larger population. However, Horner et al. (2005) recommended a minimum of three participants for single-case design, and this study contained four. Also, single case research is the most predominant form of research for children with ASD due to their individualities and the way the disability presents itself (Cooper et al., 1987). Additionally, all four subjects were receiving services at a small private clinic, meaning that they all already had access to services and multiple individuals with credentials.

A second limitation was the training of the RBTs. They had already completed a minimum of a 40-hour training and passed multiple competencies to become an RBT. This gives them an advantage of understanding the concepts used in this study. The specific terms used were all behavior analytic in nature and may not be generalizable to all classroom teachers. All

RBTs involved in this study had at least one year of experience in the field, making them knowledgeable on differential reinforcement, high-p procedures, contingencies, and prompting hierarchies. RBT's also always had access to a BCBA with extensive experience working with this particular population and may have asked questions that the researcher was unfamiliar with.

A third limitation was the days and times that intervention sessions were implemented. Due to the current schedules children had, as well as restrictions and staffing constraints due to COVID, all children did not receive the same number of days of intervention per week (e.g., some received three, some four, some five). This may impact the acquisition rate and give some children an advantage over others. Seeing as how Jim increased his acquisition rate significantly when consistent hours were introduced, it appears that the more intervention sessions had per week, the more successful the child might be. Not all children qualify for the same amount of funding, nor do they all have access to the same funding sources, which limits the number of children this may generalize to. Implementing the intervention every day without any breaks in therapy time may have led to faster acquisition of steps.

A fourth limitation was the parent and child dynamic. Parents attempted to follow all given feedback and implement the procedural fidelity checklist, however a long history of reinforcement existed between the child and parent. This means there may be inadvertent prompting happening throughout, as well as a child's preference to communicate with the parent rather than the RBT or with other individuals in the natural environment. Parents also naturally want their child to succeed and may be more willing to accept things as correct that are not necessarily correct. Therefore, the RBT took the data throughout to ensure the data were objective and based on what was occurring.

A fifth limitation is the location of the intervention. This took place in the home, with a 1:1 RBT to child ratio. This contrived environment is not always replicable. The child may also be more comfortable in the home and respond differently than they would in a more chaotic environment (e.g., a park, a school, a church).

A sixth limitation was the online training. Due to the pandemic, all methods were revised to conduct training online. This meant that the researcher could have no contact with the parent, child, or RBT. Conducting training solely online was incredibly difficult. Cameras did not always show the entire environment nor what was occurring within said environment. There were many factors that may have impacted the acquisition rate of each child that cannot be seen via a video. At times, the BCBA overseeing the case was in the home providing supervision and would be a part of the intervention. Having them in the home on a more consistent basis would be beneficial for them to support the intervention. They understand the principles of ABA and would be able to assist in the immediacy of reinforcement, differential reinforcement, and data collection.

Being that the researcher was not allowed into the homes, the dynamic between the parent and the researcher was also somewhat strained. Although the researcher held the same credentials as their current BCBA, parents did not know the person who was giving them recommendations on their child and their child's communication training. This also may have impacted the way some parents were willing to begin intervention, and the buy-in from other family members. Although the children learned the intervention, it was not as smooth as it may have been in person. The limits that come with online teaching are difficult to overcome.

A seventh limitation is the evolving nature of the iPad and the Proloquo2Go software. The iPad has fewer physical buttons for children to click, and Proloquo2Go constantly changes

the layout of the buttons on the screen. Due to this, some steps of the procedural fidelity checklist and task analysis may have to be changed in the future to accommodate for the new changes in technology and software.

An eighth limitation is that the participants did not have access to the entire intervention throughout each step in the design. Therefore, they could not pass up the current criterion and move on to a step they did not have access to. Participants only had access to the step that was being taught at the current time. Past PECS and changing criterion research has been conducted in this same manner. (Beck et al., 2008; Dogoe et al., 2010; Ganz et al., 2005; Ganz & Simspon, 2004; Lorah, 2018; Lorah et al., 2014; Marckel et al., 2006; Shrestha et al., 2013; Yokoyama et al., 2006). Also, participants did not currently have the skill in their repertoire, which may have taken away from the true nature of the changing criterion design.

Future Recommendations

This research study demonstrated that graduated guidance is an effective tool for teaching communication training via the iPad. It also demonstrated that once introduced, the iPad is used more frequently for requesting than gestures. This allows teachers and clinicians to implement communication training via the iPad from the beginning of communicative interventions, with a standardized set of steps provided to teach communication. Recommendations for future research include:

1. Replicating this research with a larger sample size, and with students with differing demographics than those included.
2. Replicating this research with older students that may have been exposed to other forms on FCT but still do not communicate functionally

3. Introducing this research in the classroom setting with teachers and paraeducators, and in a more inclusive setting than the home environment.
4. Expanding the steps to include distance and discrimination on the iPad.
5. Expanding the steps to include intraverbal language use on the iPad.
6. Expanding the steps to other devices with the same software.
7. Replicating this research with PECS as a prerequisite to show necessity or non-necessity of prerequisite skills for introduction of the iPad.
8. Developing a contingency plan for subjects that stall in one step, with proactive ways to move participants to further steps

Implications for Practice

This dissertation can add to the literature that communication training can begin with the iPad, with no other prior functional communication training. This would mean families, teachers, and clinicians would not need to invest in making all of the stimuli for PECS and teaching all phases, before introducing the iPad. This could also lend to children increasing to more intraverbal speech quickly due to the prolonged use of the iPad (Lorah et al., 2015).

Both clinicians and teachers can use this research to introduce standardized functional communication training with children with ASD via the iPad. This eliminates the need for a prerequisite to teach young children who are nonverbal a functional way to communicate. Since many families already own devices that support Proloquo2Go, this study would suggest it is possible to begin communication training with young children as early as possible. These steps can also guide teachers when deciding how to implement communication training with young children and take away the uncertainty of transferring PECS to the iPad.

This research also suggests using parents to teach new skills to children with ASD. Much research supports parent participation in treatment sessions (Dawson et al., 2010; Lovaas, 1987; Reichow, 2012) but this research also supports utilizing parents to teach novel skills that require time and patience to complete. All parents demonstrated competency with the steps and completed all intervention sessions. This could guide clinicians to not only use parents to maintain and generalize skills, but to teach new skills in conjunction with the RBT, even if a BCBA is not present.

Clinicians and teachers must also place a focus on preference assessments when working with their clients. Without effectively manipulation of motivating operations, a change in behavior cannot be expected (Cooper et al., 1987). This forces teachers and clinicians to constantly reassess what their population prefers and avoid complacency. There is also an emphasis placed on temporal contiguity and ensuring that both teachers and clinicians understand why this is important, and how this can evoke behavior change.

Conclusion

Based on all data reported above, graduated guidance was effective at teaching a task analysis on the iPad for three out of four participants involved. This same stepwise introduction of a forward chain in consistent with the teaching of PECS (Bondy & Frost, 1994). All participants learned to exchange the iPad, but only three out of the four progressed past this step. A strong functional relationship was demonstrated by two of the four participants, increasing the strength of this research for supporting graduated guidance to teach this task analysis (Cooper et al., 1987; Klein et al., 2017). Gesture use also decreased for all four participants, as the iPad became a more primary type of communication. This is aligned to past research, where participants learned to use the iPad in order to mand for desired items efficiently (Lorah et al.,

2013; Lorah et al., 2015; Lorah & Parnell, 2017; Gevartar et al., 2014). All RBTs involved in the intervention felt it was socially significant and enjoyed teaching a more functional form of communication. Parents also felt it was a successful intervention and stated that they would use the intervention in the future. This is like past research where parents prefer to use the technology of the iPad with their child (Clark et al., 2015). This research attempted to set a standard of steps that can be introduced via graduated guidance for functional communication training.

Appendix A: Parent Interview Questions

Parent Interview Questions

1. How does your child communicate?
2. Has your child ever utilized PECS before?
3. If yes, what step did they end on?
4. If no, did they ever use any other forms of alternative communication?

Appendix B: RBT Interview Questions

RBT Interview Questions

1. Have you ever attended trainings involving PECS?
2. Have you ever implemented PECS with a client?
3. If yes, what steps did you introduce with that client?
4. Have you ever utilized any AAC devices with clients?
    a. If yes, please list.
5. Have you ever used Proloquo2Go with clients?
6. If yes, how did you use it?

Appendix C: Parent/RBT Training Checklist

Parent/RBT Training Checklist

1. Demonstrate the use of Proloquo2Go and all nuances the program offers.
2. Demonstrate free operant preference assessments.
3. Parents/RBT's role play free operant preference assessments in groups of two.
4. Conduct multiple stimulus without replacement preference assessments.
5. Parents/RBT's role play multiple stimulus without replacement preference assessments in groups of two.
6. Provide Task Analysis and procedural fidelity checklist to all parents and RBT's.
7. Demonstrate all steps of procedural fidelity checklist.
8. Parents/RBT's role play all steps of procedural fidelity checklist in all roles (e.g. student, communicative partner, silent prompter).
9. Parents/RBT's are given mock examples of challenging behaviors and discuss solutions.
10. Examples and non-examples of appropriate redirection are discussed.
11. Feedback is given to each group, and all improvements are discussed.
12. Once Parents/RBT's engage in their roles two times with 100% accuracy, the training will conclude.

Appendix D: Preference Assessment Data Sheet

Preference Assessment Data Sheet

Name: _____

Date: _____

Student: _____

Type of Assessment: FREE OPERANT or MULTIPLE STIMULUS W/O REPLACEMENT

Items used:

_____

_____

Items Chosen In order:

1st._____

2nd. _____

3rd._____

4th. _____

5th. _____

6th._____

Appendix E: Discrete Trial Data Collection

Participant Name: _____

Step Number		Reinforcer	Step Number		Reinforcer	Step Number		Reinforcer
1.	C I P		1.	C I P		1.	C I P	
2.	C I P		2.	C I P		2.	C I P	
3.	C I P		3.	C I P		3.	C I P	
4.	C I P		4.	C I P		4.	C I P	
5.	C I P		5.	C I P		5.	C I P	
6.	C I P		6.	C I P		6.	C I P	
7.	C I P		7.	C I P		7.	C I P	
8.	C I P		8.	C I P		8.	C I P	
9.	C I P		9.	C I P		9.	C I P	
10.	C I P		10.	C I P		10.	C I P	
11.	C I P		11.	C I P		11.	C I P	
12.	C I P		12.	C I P		12.	C I P	
13.	C I P		13.	C I P		13.	C I P	
14.	C I P		14.	C I P		14.	C I P	
15.	C I P		15.	C I P		15.	C I P	
16.	C I P		16.	C I P		16.	C I P	
17.	C I P		17.	C I P		17.	C I P	
18.	C I P		18.	C I P		18.	C I P	
19.	C I P		19.	C I P		19.	C I P	
20.	C I P		20.	C I P		20.	C I P	

Appendix F: Task Analysis

Step	Title	Student Actions
Step 1	Exchange	Exchange a blank iPad© for reinforcement
Step 2	Home Screen	Push the home screen and swipe up on the iPad© and exchange for reinforcement
Step 3	"Item"	Press item that appears on the iPad© and exchange for reinforcement
Step 4	"I Want 'item'"	Press "I want" and the item that appears on the screen and exchange for reinforcement
Step 5	Press sentence	Press the sentence strip b after choosing "I want (item)" to speak the sentence and exchange for reinforcement
Step 6	Generalization	Generalize the above steps to one or more members of the household/one or more environments outside of the house

Appendix G: Social Validity for Parents

Social Validity Questionnaire for Parents

Name:_____ Date:_____

Relationship to Student:_____

1. My child utilizes the iPad to request at home: YES NO
2. I understand how to assist my student with the iPad: YES NO
3. I will continue to utilize the iPad in the home: YES NO

   Circle One:

4. My child PREFERS **or** DOES NOT PREFER to communicate via the iPad.
5. My child COMMUNICATES MORE **or** COMMUNICATES LESS following intervention.
6. My child prefers to use the IPAD **or** PECS BOOK **or** GESTURES to communicate
7. I would prefer my child use the IPAD **or** PECS BOOK **or** GESTURES to communicate.
8. What I like about the my child using the iPad:

   _____

   _____

9. What I did not like about my child using the iPad:

   _____

   _____

Appendix H: Social Validity for Registered Behavior Technicians

Social Validity Questionnaire for Registered Behavior Technicians

Name:_____ Date:_____

1. I found this intervention easy to learn: YES NO
2. I found this intervention helpful in therapy sessions: YES NO
3. I found this intervention helpful to my client: YES NO
4. I understand why this intervention was implemented: YES NO
5. I understand how to implement this intervention: YES NO
6. I will implement this intervention with future clients: YES NO
7. The skills taught to my clients were USEFUL or USELESS.
8. Utilizing the iPad was MORE or LESS stigmatizing than other communication devices.
9. My client prefers the IPAD or GESTURES more.
10. What I liked about the intervention:

    _____

    _____

11. What I did not like about the intervention:

    _____

    _____

12. What I would change about the intervention:

    _____

    _____

Appendix I: Frequency Data Sheet for Gestures

Participant Name: _____

Date: _____

Gesture	Item Participant Gestured For

Appendix J: Prompting Hierarchy

Prompting Hierarchy	
1. Full physical prompt-hand over hand assistance to complete the step and exchange the iPad	
2. Partial physical prompt-hand over hand assistance to begin the step without prompting to exchange the iPad	
3. Partial physical prompt-tap the student on the arm to begin the step	
4. Gestural prompt-point to the iPad to begin the step	

Appendix K: Procedural Fidelity Checklist

Procedural Fidelity Checklist

Step 1: Exchange		High-P Was Used
5. Student sits at desk across from communicative partner		Y/N
6. Silent prompter stands behind student		Y/N
7. Blank iPad sits on desk in front of student		Y/N
8. Communicative partner holds reinforcer in their hand/on the table		Y/N
9. When student reaches for reinforcer, silent prompter moves students' hands to pick up iPad and begins prompting hierarchy		Y/N
10. If student does not reach for reinforcer within 10-seconds, follow the prompting hierarchy.		Y/N
11. Silent prompter proceeds to prompt student to hand iPad to communicative prompter		Y/N
12. Communicative prompter immediately hands reinforcer to student		Y/N
13. Communicative prompter verbally labels reinforcer (e.g. "Cookie!")		Y/N
14. Child is allowed 30 seconds to access reinforcer		Y/N

15. Reinforcer is placed back in the communicative partner's hands		Y/N
16. Blank iPad is placed back in front of student		Y/N
17. Repeat steps 1-12 until student independently reaches for the iPad before reaching for the reinforcer		Y/N
18. Student independently reaches for iPad and exchanges with communicative partner unassisted		Y/N
19. Communicative partner immediately hands reinforcer to student		Y/N
20. Communicative prompter verbally labels reinforcer (e.g. "Cookie!")		Y/N
21. Child is allowed 30 seconds to access reinforcer		Y/N
22. Once successful with steps 14-17 for 2 consecutive data points, move on to step 2.		Y/N
Step 2: Screen and Swipe		
1. Student sits at desk across from communicative partner		Y/N
2. Silent prompter stands behind student		Y/N
3. Blank iPad sits on desk in front of student		Y/N
4. Communicative partner holds reinforcer in their hand/on the table		Y/N
5. Student has previously mastered step 1-When they attempt to exchange the iPad for the reinforcer the silent		Y/N

prompter will prompt lighting up the screen and swiping up		
6. If student does not attempt to communicate within 10-seconds, follow the prompting hierarchy		Y/N
7. Student hands iPad to communicative partner		Y/N
8. Communicative partner immediately hands reinforcer to student		Y/N
9. Communicative partner verbally labels reinforcer (e.g. "Cookie!")		Y/N
10. Child is allowed 30 seconds to access reinforcer		Y/N
11. Reinforcer is placed back in the communicative partner's hands		Y/N
12. Blank iPad is placed back in front of student		Y/N
13. Repeat steps 1-13 until student independently lights up the screen and swipes up		Y/N
14. Student independently lights up the screen and swipes up		Y/N
15. Communicative partner immediately hands reinforcer to student		Y/N
16. Communicative prompter verbally labels reinforcer (e.g. "Cookie!")		Y/N
17. Child is allowed 30 seconds to access reinforcer		Y/N

18. Once successful with steps 14-17 for 2 consecutive data points, move on to step 3.		Y/N
Step 3: "Item"		
1. Student sits at desk across from communicative partner		Y/N
2. Silent prompter stands behind student		Y/N
3. Blank iPad sits on desk in front of student		Y/N
4. Communicative partner holds reinforcer in their hand/on table		Y/N
5. Student has previously mastered step 2-When they attempt to exchange the iPad after lighting up the screen and swiping up, the silent prompter will prompt the student to press the picture of the desired item on the screen		Y/N
6. If student does not attempt to communicate within 10-seconds, follow the prompting hierarchy		Y/N
7. Student hands iPad to communicative partner		Y/N
8. Communicative prompter immediately hands reinforcer to student		Y/N
9. Communicative prompter verbally labels reinforcer (e.g. "Cookie!")		Y/N
10. Child is allowed 30 seconds to access reinforcer		Y/N
11. Reinforcer is placed back in the communicative partner's hands		Y/N

12. Blank iPad is placed back in front of student		Y/N
13. Repeat steps 1-12 until student independently clicks the "item" button before exchanging the iPad		Y/N
14. Student independently presses the home button twice and clicks the picture of the "item" before exchanging with the communicative partner unassisted		Y/N
15. Communicative partner immediately hands reinforcer to student		Y/N
16. Communicative prompter verbally labels reinforcer (e.g. "Cookie!")		Y/N
17. Child is allowed 30 seconds to access reinforcer		Y/N
18. Once successful with steps 14-17 for 2 consecutive data points, move on to step 4.		Y/N
Step 4: "I Want 'item'"		
1. Student sits at desk across from communicative partner		Y/N
2. Silent prompter stands behind student		Y/N
3. Blank iPad sits on desk in front of student		Y/N
4. Communicative partner holds reinforcer in their hand/on the table		Y/N
5. Student has previously mastered step 3-When they attempt to exchange the iPad after lighting the screen and swiping up, the silent prompter will prompt the		Y/N

student to press “I want” folder icon and the picture of the desired item		
6. If student does not attempt to communicate within 10-seconds, follow the prompting hierarchy		Y/N
7. Student hands iPad to communicative partner		Y/N
8. Communicative prompter immediately hands reinforcer to student		Y/N
9. Communicative prompter verbally labels reinforcer (e.g. “Cookie!”)		Y/N
10. Child is allowed 30 seconds to access reinforcer		Y/N
11. Reinforcer is placed back in the communicative partner’s hands		Y/N
12. Blank iPad is placed back in front of student		Y/N
13. Repeat steps 1-12 until student independently clicks the “I want” button and the picture of the desired item before exchanging the iPad		Y/N
14. Student independently presses the home button twice and clicks the “I want” icon and the desired item before exchanging with the communicative partner unassisted		Y/N
15. Communicative partner immediately hands reinforcer to student		Y/N
16. Communicative prompter verbally labels reinforcer (e.g. “Cookie!”)		Y/N

17. Child is allowed 30 seconds to access reinforcer		Y/N
18. Once successful with steps 14-17 for 2 consecutive data points, move on to step 5.		Y/N
Step 5: Press sentence to speak		
1. Student sits at desk across from communicative partner		Y/N
2. Silent prompter stands behind student		Y/N
3. Blank iPad sits on desk in front of student		Y/N
4. Communicative partner holds reinforcer in their hand/on the table		Y/N
5. Student has previously mastered step 4-When they attempt to exchange the iPad after clicking the "I want" icon and the desired item, the silent prompter will prompt the student to press the sentence on the top of the screen to speak the sentence		Y/N
6. If student does not attempt to communicate within 10-seconds, follow the prompting hierarchy		Y/N
7. Student hands iPad to communicative partner		Y/N
8. Communicative prompter immediately hands reinforcer to student		Y/N
9. Communicative prompter verbally labels reinforcer (e.g. "Cookie!")		Y/N
10. Child is allowed 30 seconds to access reinforcer		Y/N

11. Reinforcer is placed back in the communicative partner's hands		Y/N
12. Blank iPad is placed back in front of student		Y/N
13. Repeat steps 1-12 until student independently clicks the "I want" button and the picture of the desired item as well as the sentence strip before exchanging the iPad		Y/N
14. Student independently lights up the screen, swipes up, and clicks the "I want" icon and the desired item and the sentence strip before exchanging with the communicative partner unassisted		Y/N
15. Communicative partner immediately hands reinforcer to student		Y/N
16. Communicative prompter verbally labels reinforcer (e.g. "Cookie!")		Y/N
17. Child is allowed 30 seconds to access reinforcer		Y/N
18. Once successful with steps 14-17 for 2 consecutive data points, move on to step 6.		Y/N
Step 6: Generalization		
1. Student sits at desk across from novel communicative partner		Y/N
2. Silent prompter stands behind student		Y/N
3. Blank iPad sits on desk in front of student		Y/N

4. Communicative partner holds reinforcer in their hand/on the table		Y/N
5. If student does not attempt to communicate within 10-seconds, follow the prompting hierarchy		Y/N
6. Student hands iPad to communicative partner		Y/N
7. Communicative prompter immediately hands reinforcer to student		Y/N
8. Communicative prompter verbally labels reinforcer (e.g. "Cookie!")		Y/N
9. Child is allowed 30 seconds to access reinforcer		Y/N
10. Reinforcer is placed back in the communicative partner's hands		Y/N
11. Blank iPad is placed back in front of student		Y/N
12. Repeat steps 1-11 until student is exchanging with novel communicative partners		Y/N

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Curriculum Vitae

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EDUCATION

Ph.D. Early Childhood, Multilingual, and Special Education, Special Education, University of Nevada, Las Vegas (01/2015-present)

M. Ed. Education and Clinical Studies, Special Education, University of Nevada, Las Vegas (01/2013-06/ 2014)

B.A. Psychology, University of Nevada, Las Vegas (09/2009-12/2012)

NATIONAL CERTIFICATION AND STATE LICENSURE

L.B.A. # LBA0056
Licensed Behavior Analyst

B.C.B.A. # 1-15-18200
Board Certified Behavior Analyst

CERTIFIED TRAINING

06/2019 Behavioral Safety Specialist

08/2015 Cardiopulmonary Resuscitation

03/2019 Basic Life Support Training

PROFESSIONAL POSITIONS

06/2008-09/2013 **Discrete Trial Instructor**, Las Vegas, Nevada. Private contractor. Responsible for serving as the primary interventionist in the education and treatment of children with autism by providing 1:1 in-home behavioral treatment and attending monthly workshops.

09/2013-Present **Licensed Board Certified Behavior Analyst**, The Lovaas Center for Behavior Intervention, Las Vegas, Nevada. Responsible for training workshops and consultation services for the intensive early intervention for children with Autism Spectrum Disorder using discrete trial instruction

PRESENTATIONS

January 2015, Families for Effective Autism Treatment of Southern Nevada (FEAT), Evidence based treatment via the use of discrete trial instruction and application of Applied Behavior Analysis and the clinical significance of 40-hours per week of early intervention for children with Autism Spectrum Disorder. Las Vegas, Nevada

April 2015, Families for Effective Autism Treatment of Southern Nevada (FEAT), Evidence based treatment via the use of discrete trial instruction and application of Applied Behavior Analysis and the clinical significance of 40-hours per week of early intervention for children with Autism Spectrum Disorder. Las Vegas, Nevada

April 2015, Saunders, J. &Pfatenhauer, T. (2015). Social Motivation to Increase Student Participation. (White Paper Presentation).

May 2015, Saunders, J. (2015). Utilizing Socially Motivating Techniques to Remediate Credit Deficiency. University of Nevada, Las Vegas. (In class presentation).

June 2015, Families for Effective Autism Treatment of Southern Nevada (FEAT), Evidence based treatment via the use of discrete trial instruction and application of Applied Behavior Analysis and the clinical significance of 40-hours per week of early intervention for children with Autism Spectrum Disorder. Las Vegas, Nevada

September 2015, Families for Effective Autism Treatment of Southern Nevada (FEAT), Evidence based treatment via the use of discrete trial instruction and application of Applied Behavior Analysis and the clinical significance of 40-hours per week of early intervention for children with Autism Spectrum Disorder. Las Vegas, Nevada

January 2015, Families for Effective Autism Treatment of Southern Nevada (FEAT), Evidence based treatment via the use of discrete trial instruction and application of Applied Behavior Analysis and the clinical significance of 40-hours per week of early intervention for children with Autism Spectrum Disorder. Las Vegas, Nevada

May 2015, Families for Effective Autism Treatment of Southern Nevada (FEAT), Evidence based treatment via the use of discrete trial instruction and application of Applied Behavior Analysis and the clinical significance of 40-hours per week of early intervention for children with Autism Spectrum Disorder. Las Vegas, Nevada

August 2015, The Lovaas Center for Behavior Intervention (TLC-BI), Evidence based treatment via the use of discrete trial instruction and application of Applied Behavior Analysis and the clinical significance of 40-hours per week of early intervention for children with Autism Spectrum Disorder. Las Vegas, Nevada

October 2015, Families for Effective Autism Treatment of Southern Nevada (FEAT), Evidence based treatment via the use of discrete trial instruction and application of Applied Behavior Analysis and the clinical significance of 40-hours per week of early intervention for children with Autism Spectrum Disorder. Las Vegas, Nevada

Nov 2016 to

Present, The Lovaas Center for Behavior Intervention
Evidence based treatment via the use of discrete trial instruction and application of Applied Behavior Analysis and the clinical significance of 40-hours per week of early intervention for children with Autism Spectrum Disorder. Las Vegas, Nevada

October 2017, Saunders, J. (2017). *Discrete Trial: You Do it Too!* Poster presented at the Division for Early Childhood Conference, Portland, OR.

TEACHING EXPERIENCE

Nov 2017, Guest Lecture, ESP 729, Characteristics of Autism Spectrum Disorder. *Communication and ASD*, University of Nevada Las Vegas

Jan-Feb 2018, Instructor of Record, ESP 740, *Speech and Hearing Therapy for Classroom Teachers*. University of Nevada Las Vegas

July-Aug 2018, Instructor of Record, ESP 762, *Ethical Evaluations of Programs for Persons with Exceptionalities/Special Needs,* University of Nevada Las Vegas

Sep-Oct 2018, Instructor of Record, ESP 735, *Advanced Behavior Management*, University of Nevada Las Vegas

July-Aug 2019, Instructor of Record, ESP 762, *Ethical Evaluations of Programs for Persons with Exceptionalities/Special Needs,* University of Nevada Las Vegas

May-June 2020, Instructor of Record, ESP 715, *Communication Programming for Persons with Severe Disabilities,* University of Nevada Las Vegas

May-June 2021, Instructor of Record, ESP 715, *Communication Programming for Persons with Severe Disabilities,* University of Nevada Las Vegas

SERVICE

Nevada Association for Behavior Analysis
Council for Exceptional Children

PROFESSIONAL DEVELOPMENT

Nevada Association for Behavior Analysis Conference (Attendee) 2015
Division for Early Childhood (Presented) 2017
Nevada Association for Behavior Analysis Conference (Attendee) 2020