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Video Based Intervention and Backward Chaining: Teaching Children with Autism

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VIDEO BASED INTERVENTION AND BACKWARD CHAINING: TEACHING CHILDREN WITH AUTISM

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ABSTRACT

As we move further and further into the digital age, interventions that make use of advances in technology will become increasingly relevant. One example of the application of technology is Video Based Interventions (VBI). VBIs include interventions that utilize pre-recorded video footage to assist acquisition of functional life skills, social and play skills, and adaptive behaviors, among others (Rayner, Denholm, & Sigafoos, 2009). Due to the breadth of the term, there are many different types of VBIs that have been examined in research and practice. This study examined one type of VBI, video prompting, and its effectiveness when combined with backward chaining. Prior research suggested that both VBIs (Bellini & Akullian, 2007; Rayner et al., 2009), backward chaining (Batra & Batra, 2005; Walls & Zane, 1981), and their combination (Moore, Anderson, Deppeler, & Furlonger, 2013), are effective intervention methods for skill acquisition. Using a single-subject multiple baseline design, this experiment expands the current literature by examining backward chaining and a VBI for the acquisition of the shoe tying behavior in children with Autism Spectrum Disorder. The results obtained from this study support prior research that VBIs are effective and their effectiveness is influenced by a number of factors. We also found that majority of the participants were able to retain their newly acquired behaviors one week after achieving mastery.

CHAPTER 1: INTRODUCTION

Learning via observation and imitation is a fundamental part of the developmental process for children (Bandura, 1977; Meltzoff, 1990). The acquisition of skills as divergent as writing and social interaction are largely dependent on these two abilities. Imitation is defined as the action of reproducing any observed bodily or facial movement; however, this definition can also involve vocal and visual imitation (i.e. visual pursuit and joint attention) as well as any movement that is imitated with or without objects (Malvy et al., 1999; Warreyn, Van der Paelt, & Roeyer, 2014). Children with Autism Spectrum Disorder (ASD) have been shown to possess significant deficits in their imitation abilities (Smith & Bryson, 1994). This difficulty in imitation can make it extremely challenging for a child with ASD to learn new skills. In an attempt to combat this deficit, Video Based Interventions (VBI) have been utilized in the acquisition of life skills for children with ASD. Prior research supports the idea that these interventions are an effective and practical method of skill acquisition for children with ASD (Rayner, Denholm, & Sigafoos, 2009). While research on VBI has shown that it can be successful, there are consequential limitations to its application. One limitation of VBI, in its most common form, is that it is typically similar to whole task training. The participant is shown the entire behavior or skill and asked to imitate the model. This can be particularly troublesome for children with ASD due to deficits in spatial working memory (Matson et al., 1996; Minshew, Williams, & Goldstein, 2006).

In an attempt to better understand factors that may help to avoid this problem and improve the treatment effectiveness of VBIs, recent research has examined alternative VBI methods (Cannella-Malone et al., 2006; Rayner et al., 2009; Sancho, Sidener, Reeve, & Sidener, 2010). The VBI employed in this study is video prompting. Video prompting differs from

traditional video modeling in that it involves separating the video into a number of prompted steps. The participant then learns the behavior from the model, step by step, similar to part task training. Prior research supports the use of video prompting for skill acquisition in individuals with intellectual and developmental disabilities (Aykut, Ç., Dagseven Emecen, D., Dayi, E., & Karasu, N., 2014; Cannella-Malone et al., 2006; Graves, Collins, Schuster, & Kleinert, 2005; Norman, Collins, Schuster, 2001).

While there is agreement in the research literature that the three forms of response chaining (backward, forward, and total task) are effective in the acquisition of new behaviors, these is little consensus on whether one is more efficacious than another (Cooper, Heron, & Heward, 2007). This study combines video prompting with backward chaining. We chose backward chaining because the point of reinforcement remains constant for the child. VBIs and response chaining procedures have been used together with forward chaining (Shrestha, Anderson, & Moore, 2013; Tereshko, MacDonald, & Ahearn, 2010) and backward chaining (Moore, Anderson, Deppeler, & Furlonger, 2013; Rayner, 2011). The main purpose of this experiment is to extend the literature in order to create more accessible treatment methods. We generally hypothesized that the children will master the target behaviors.

CHAPTER 2: LITERATURE REVIEW

Video Based Intervention

With the advent of technology, practitioners and researchers have developed new forms of early treatment and intervention methods for children with ASDs. One form of intervention method that has been gaining popularity in the literature are VBIs. The VBI therapy method makes use of technology by allowing a model to be videotaped and subsequently replayed numerous times in order to model behaviors for a wide variety of individuals. VBI generally involves a participant actively observing a video recording of a model performing a target behavior. Due to the flexibility of technology and video recording, VBI has been used with many different populations to teach a multitude of behaviors (Bellini & Akullian, 2007).

Bellini and Akullian (2007) recently conducted a meta-analysis regarding video modeling and Video Self-Modeling (VSM) for individuals with ASD. In studies that targeted functional skills, the two types of VBI were not only found to be effective in self-help skill acquisition, but also in the generalization and maintenance of the newly learned skills (Bellini, Akullian, & Hopf, 2007). Norman and colleagues (2001) examined the effectiveness of a VBI treatment package in self-help skill acquisition. Using a first-person point-of-view model and video prompting, the researchers found that the treatment package was effective for teaching self-help skills to individuals with intellectual disabilities (Norman et al., 2001). Similar results were found for VBI's effectiveness teaching daily living (Shipley-Benamou, Lutzker, and Taubman, 2002) and self-help skills (Shrestha et al., 2013).

Bellini and Akullian (2007) also found VBIs to be a generally effective form of treatment for the social and communicative deficits that are prevalent in children with ASD. More recent research has supported their results and found that VBIs are effective for the instruction and

increased engagement of play and other social communication skills (Bellini & Akullian, 2007; Sancho et al., 2010). An additional benefit of VBIs is that VBIs allow for the removal of irrelevant behaviors in order to provide the observer with a clearer representation of the target behavior, effectively providing the child with a highly accurate and consistent model. The majority of the interventions examined found similar results regardless of methodological differences (i.e. video model versus VSM, age of participant, setting, or diagnostic criteria; Bellini & Akullian, 2007).

Theoretical Foundations

Social Learning Theory. The construct of observational learning through modeling originated as part of Albert Bandura's Social Learning Theory (Bandura, 1977). Bandura stated that skill development in young children is facilitated primarily through observing others. Previous research has noted that when active observation is facilitated, observers were able to increase their feelings of self-efficacy through task completion as well as generalize the newly learned behaviors (Bandura, 1969; Bandura, 1977; Lewis, 1974; Ritter, 1969). The appearance of this increase in self-efficacy falls in line with Bandura's (1977) idea of self-efficacy (i.e. an individual's performance will be influenced by their beliefs that they can perform at an acceptable level). Video modeling, due to the elimination of modeling errors, should prove more effective than the real time observation of others. Previous research has also noted the potential link between this idea of self-efficacy and video self-modeling, stating that if individuals are able to observe themselves successfully performing a behavior, they will be more motivated to perform the behavior again (Bellini & Akullian, 2007).

Response Chaining. Response chaining is a method of behavior modification that is widely used by the scientific community as well as by practitioners (Slocum & Tiger, 2011).

This method involves a number of responses that are linked to stimulus conditions. These stimulus conditions allow each response to serve as a discriminative stimulus for the preceding response and as well as a conditioned reinforcer for the following behavior, thereby creating a chain of behaviors that result in terminal reinforcement (Cooper et al., 2007). Research supports the hypothesis that response chaining is useful in teaching functional skills to individuals with disabilities, allowing the individual to build up their ability to correctly perform the behavior and increase their self-efficacy (Batra & Batra, 2006; Rayner. 2011, Slocum & Tiger, 2011; Smith, 1999).

General response chaining procedures can be broken down into two major teaching methods; part and whole. Part procedures involve breaking a behavior down into a number of steps that are presented one at a time to the participant. In this method, participants are able to master one step before moving on to the next (Teague, Gittelman, & Park, 1994). For example, if a participant is required to learn the behavior sequence ABCD, they will have to master A before moving onto trying B and so on. Whole procedures involve a participant performing and learning the behavior or skill in its entirety. Participants will be shown and asked to perform the behavior as a single unit. This can be beneficial because it eliminates the process of having to combine all of the steps to recreate the entire behavior (Teague et al., 1994).

The question of whether one method is more effective than the other has been examined extensively in the research literature. Steffens (1900; cited by Teague et al., 1994) was the first researcher to examine this question. In Steffens' (1900; cited by Teague et al., 1994) experiment, participants were asked to memorize poetry. One group memorized a stanza (whole condition) and the other group memorized each line of the stanza one at a time (part condition). Steffens found that the whole procedure was more efficient in the memorization of the stanza. Naylor and

Briggs (1963) then went on to examine differences in the part and whole training methods when there was a variation in task complexity and organization. They concluded that part training was more effective for unorganized, complex tasks, whereas, whole training was more effective for organized tasks (Naylor & Briggs, 1963).

There are three types of response chaining that are utilized in the literature, forward chaining, backward chaining, and total task. In forward chaining, the chaining process begins with the first step in the process. The participant is taught to complete the first step and reinforcement is contingent upon completing that step. The participant then has to complete a new step in addition to the previously mastered step in order to attain reinforcement. One of the benefits to forward chaining is that it can be used to combine low complexity behavior response chains into larger, more complex chains. Backward chaining, on the other hand, begins with the last step. The participant is presented with a task with only the final step to complete, which is the target of initial training. Once that step is mastered, the participant will learn to perform the second to last step in addition to the last step. This process continues on until the participant can complete the task or behavior in its entirety. This training method makes the reinforcement requirements easier for the participant to understand because the point of reinforcement will always be the last step, unlike with forward chaining. Lastly, the process for total-task chaining is very similar to whole task training in that the researcher presents the entire task on every trial and assists the participant through the steps. A benefit of total-task training is that it may prove more effective when used with small, less complex behavior chains. Prior research has failed to find consistent evidence that one training method is more effective, however, there is general consensus training methods should be chosen based on the task requirements and the needs of the individual (Cooper et al., 2007).

Autism Spectrum Disorder

Prevalence. The rate at which children are being diagnosed with Autism is steadily increasing. According to the Center for Disease Control and Prevention (2010), 1 out of every 68 children has been diagnosed with ASD. Males also exhibit higher prevalence than females (CDC, 2010). While it appears that the prevalence rate for children with ASD is increasing, this may be a result of changing diagnostic standards, tools, and increasing awareness of ASD. The increasing prevalence rates of children with ASD has created tremendous challenges for parents, policy makers, clinicians, and schools in terms of providing effective care and treatment.

Characteristics. The Diagnostic and Statistical Manual of Mental Disorders – 5th Edition (American Psychiatric Association, 2013) describes individuals with ASD as characterized by deficits in their social and cognitive development as well as restricted, repetitive patterns of behavior and interests. Many individuals with this disorder fail to produce or engage in conversational behavior, have problems in the use of nonverbal communicative behaviors, and show difficulties in maintaining or developing relationships (American Psychiatric Association, 2013). These individuals also have difficulty displaying, sharing, or understanding the emotions of others (i.e. theory of mind; American Psychiatric Association, 2013). In addition to the characteristics described in the DSM-5 (2013), prior research has examined this disorder in an attempt to better understand of some of its more ambiguous characteristics.

Early directions in research have also led to an examination of the deficits in social learning that are characteristic of individuals with ASD. Prior research has shown that children with ASD typically show deficits in their ability to imitate (Berument, Rutter, Lord, Pickles, & Bailey, 1999; Gillberg et al., 1990; Malvy et al., 1999). Malvy et al., (1999) devised a clinical scale, the Imitation Disorders Evaluation Scale (IDE), which was used to evaluate the various

early features of the imitation deficit in children with ASD (Malvy et al., 1999). Malvy et al. (1999) found that imitation of gesture and visual pursuit were the least impaired out of all the imitation features examined. Through the use of the IDE scale, parental interviews, paediatric examinations, and developmental assessments, Malvy et al. (1999) were able to confirm that a deficit in imitation ability is present in children with ASD. Impaired imitation ability has also been used as a form of inclusion criteria for studies that involve children with Autism (Gillberg et al, 1990). This imitation deficit is important because it interferes with children with ASD's ability to learn.

When considering the effectiveness of VBIs, imitation ability is a significant factor in predicting whether or not an intervention would result in positive outcomes for a child. This is not to say that VBIs are completely ineffective for children with ASDs. In fact, as previously stated, VBIs were found to be effective in functional skill acquisition for children with ASDs (Bellini & Akullian, 2007). The main question one should ask when deciding whether or not to use VBI is whether or not the child possesses the necessary pre-requisite abilities to benefit from this treatment.

Pre-Requisites for Video Based Intervention

Although previous research is inconclusive as to whether or not the presence or absence of pre-requisites can affect the effectiveness of VBI, many studies make use of a number of inclusion criteria (Rayner et al., 2009). These pre-requisites vary across studies, but the main pre-requisites are that the child must be able to actively observe a video screen for an extended period of time, have adequate imitation skills, and have adequate auditory acuity (Rayner et al., 2009). While there is research supporting the idea that imitation abilities are needed for VBIs (Lindsay, Moore, Anderson, & Dillenburger, 2013), there is a lack of adequate screening tools

and inclusionary criteria that can predict intervention success (Rayner et al., 2009). Methods such as teacher report (Shipley-Benamou et al., 2002) as well as requiring the child to demonstrate adequate attention span (Sancho et al., 2010) and imitation ability (Rayner, 2011) are some of the more common forms of inclusionary criteria. Some researchers have even used imitation scales in an attempt to determine whether or not the child would be suitable for the intervention (Stone, Ousley, & Littleford, 1997).

CHAPTER 3: RESEARCH PURPOSE AND QUESTIONS

The purpose of this study was to examine the effectiveness of a treatment package, involving video prompting and backwards chaining, for functional skill acquisition in children with ASD. The target behavior was shoe tying and each child's ability to imitate was evaluated through the use of the Imitation Disorders Evaluation Scale. Performance results were measured across four intervention phases (baseline, video prompting, retention, and generalization).

Procedural variations of VBIs have been shown to be effective in skill acquisition for individuals with ASD, however, there are still many unanswered questions regarding the use of VBI in combination with other treatments (Bellini & Akullian, 2007; Rayner et al., 2011). Bellini and Akullian (2007) discussed a few studies that have utilized VBI in conjunction with other treatments, however, they note that 3 out of 4 of the reviewed studies found some of the lowest intervention effects in the meta-analysis. Upon further investigation, probable causes for the observed low intervention effects include limitations such as brief intervention periods (Hagiwara & Myles, 1999), lack of sufficient intervention trials over a lengthy period of time (Ogletree & Fischer, 1995), and inclusion of unnecessary or extra behaviors being performed by the model (Thiemann & Goldstein, 2001). Drawing from previous studies, this study examines VBI's effectiveness when paired with another treatment. In regards to studies that have examined VBIs combined with backward chaining, the research is limited (e.g., Cannella-Malone et al., 2006).

The current study examined the combined effectiveness of video prompting and backward chaining to teach a complex self-care skill: shoe tying. We hypothesized that the treatment package, in general, would be effective for acquisition of the target behavior. We also hypothesized that, after having reached mastery of the behavior while engaged with the treatment

package, the participants would be able to reliably demonstrate retention of the acquired behavior.

CHAPTER 4: METHODS

Participants

Three children that have met the DSM-5 classification for mild to moderate autism (American Psychiatric Association, 2013) were recruited to participate in this study. For the purposes of this study, the names of the three children are Carl, Leiliste, and Artico. The age of the selected participants ranged from 4-6 years of age. All participants were selected from the Emerge Center for Communication, Behavior, and Development. Parental written consent was obtained for each participant prior to the start of the study. Caregivers were also asked to complete and submit a demographic questionnaire.

Demographic Questionnaire

The caregivers of each child completed a demographic questionnaire prior to the start of the experiment. In this questionnaire, caregivers provided information regarding their child's age, name, gender, birth order, ethnicity, language spoken at home, etc. The caregiver's also included their own age, education level, and occupation.

Screening Procedure

Imitation Disorders Evaluation Scale. The results from a modified version of the Imitation Disorders Evaluation (IDE) scale were obtained and used as inclusion criteria to evaluate each participant's imitation ability. This scale was chosen because it is a validated scale for assessing the imitation abilities of children with autism (Malvy et al., 1999). The assessment consisted of a parental measure of their child's imitation ability as well as an observation session in which a researcher observed the child perform the behaviors in the five items of the IDE scale. The IDE scale has been modified to eliminate items that were irrelevant to the current study.

The modified Imitation Disorders Evaluation scale is scored on a five-point scale which ranges from zero to four points. A child received zero points if there were no observations of the behavior, one point if the behavior was successfully imitated one out of four times, two points if the behavior was successfully imitated two out of four times, three points if the behavior was successfully imitated three out of four times, and four points if the behavior was successfully imitated for all attempts. Inclusion for the study required a score of two or higher on each item. The modified IDE scale is presented in Table 1 in the appendix. See appendix for examples of imitation situations.

Selection of Cartoons. After completing the IDE scale, participants were asked to name their favorite cartoon or show. The researcher then found a YouTube video of the show and observed the child's behavior while watching the video. This was included in screening because, as stated by Rayner and colleagues (2009), one pre-requisite for VBI is the child's ability to focus their attention towards a video screen.

Setting

All experimental sessions occurred in similar rooms. The rooms contained a table accompanied by a laptop, chairs for both the researcher and the child, and any toys that the child wanted to play with during their breaks. A researcher was also present to video record the child's progress and prompt the child's focus towards the instructional video if needed.

Stimuli

Prior to the start of the experiment, each child sat down at a table in the center of the room. Videos were made to demonstrate the performance of each step in the shoe tying chain. The videos contained two main parts, one in which a short cartoon is played for five seconds, after the cartoon, a clip of the step being performed was played. Each child observed a cartoon

selected based on their preference obtained during the screening procedure. Both Carl and Artico chose to watch clips from the Disney movie *Pets*, while Leiliste chose clips from *Super Why!*. This video stimulus was adapted from the video modeling study conducted by Hine and Wolery (2006). The length of each video ranged from 10 seconds to 30 seconds, depending on the number of steps in the chain. The shoe tying behavior in the video was broken down into 6 steps; (1) pick up and cross laces with the left lace over the right, (2) make an overhand knot with the new left lace, (3) create the left loop, (4) create the right loop, (5) cross both loops, (6) complete the second overhand knot. The five second cartoon was played prior to each chain of steps that the child is currently engaged in. For example, if the child is currently working on steps six and five, the cartoon will only play once, prior to the presentation of the fifth step. After each video segment, the researcher will place the shoe in front of the child and prompt them to complete the step. During steps 3-6, the laces were held together with pipe cleaners.

Experimental Design

This study used a multiple baseline design with four phases Baseline, Video Prompting, Retention, and Generalization.

Independent Variable. The independent variable used in this experiment was the video augmented backward chaining procedure. Six videos were created (one for each chain) and recorded.

Dependent Variable and Data Collection. The dependent variables were the completion of the steps within the task, the number of trials needed to reach mastery, and the time it took each child to tie the shoe during the retention phase. During each phase, the number of steps completed were recorded and used as the child's step completion score. In order to parallel the backward chaining procedure, data collection began with the last step in the response

chain. The child was presented with and prompted to complete either a single step or a chain of steps, depending on the phase. The child's step completion progress was recorded after each trial.

Procedure

Each child was accompanied into the intervention room by a researcher. The researcher began recording as soon as the child entered the room and prompted the child to sit at the table. After sitting down, the researcher played the video on the laptop.

Baseline. During the baseline phase, data collection trials were provided as described above. After each baseline trial, the researcher praised the child for performing, or attempting to perform the behavior, and allowed access to a pre-selected toy from a toy closet at the center. No instructions, assistance, or treatment other than the verbal prompt were provided. Reinforcers were selected via access to an on-site toy closet.

Video Prompting. The researcher prompted the child to watch the video that accompanied the current step. After the participants watched the video, a shoe that has been completed up to the current step, was placed in front of the child. The researcher then prompted the child to complete the step(s) on the shoe in front of them. After the child had attempted or completed the step, the researcher praised the child for their hard work and replaced the shoe with a preferred reinforcer for 30 seconds. The shoe was then reset to the previous step. Training progressed to the next step when the participant completed three consecutive trials correctly within the same session. Following failed attempts at step completion, the researcher stated, "I like how hard you worked. Let's watch the video and try again!" The participant was then shown the video that corresponded the current step and prompted to try again. If the participant was still unable to perform the step, the researcher replayed the video for a third time, physically assisted

the child in performing the step (if necessary), and the child was given praise and their preferred toy. In one instance the participant did not perform a previously mastered step on three consecutive teaching trials, the current trial was ended, and a probe on the aforementioned step was conducted. Instructional sessions consisted of three trials each with each trial providing up to three attempts (two video modeling only and one with physical guidance if needed). Each session lasted for 10-15 minutes. Backward chaining continued until the participant reached mastery of the chain.

Retention. One week after the video prompting phase was completed, the retention phase session was conducted. Each child was given an untied shoe that was oriented towards them. The children were prompted to tie the shoe. The child was given no assistance or further instruction. A time limit of three minutes was set for each child. When the child finished, or the time ran out, the child was praised for their hard work and given a preferred reinforcer. This sequence of events occurred over three trials with one minute breaks in between the trials.

Generalization. During this phase, the participants completed the chain while the shoe was on their foot. Each participant was probed for one trial to determine how much of the chain had generalized before the generalization training began. Once the participants had demonstrated mastery during the generalization phase, they exited the study.

Treatment Integrity and Procedural Checklist

Treatment Integrity was obtained for the four experimental phases. Video recordings were reviewed and evaluated using a checklist based on the research protocol for each experimental phase. Independent observers observed and scored treatment integrity for 20% of the sessions. Treatment integrity was then calculated by dividing the total number of correctly

performed items by the total number of items on the checklist. The treatment integrity for the study was 97%.

CHAPTER 5: RESULTS

A graph of participant performance is presented in Figure 1. None of the participants completed a step in the shoe tying chain during the baseline trials. All participants also engaged in a behavior that was not related to the shoe tying during baseline. Blocking (minimal physical assistance to reduce the appearance of problematic behaviors) and full physical assistance procedures (three trials involving immediate physical assistance) were implemented to extinguish the competing behaviors of Carl and Leiliste. It is also worth noting that participants' data intermittently returned to 0 correct responses when their training progressed (see Figure 1). This occurred as an artifact of the data collection and training procedure with backward chaining. When Carl mastered step 6 and data collection moved back to steps 5 and 6, he was initially unable to complete the new chain.

Carl

During the baseline trials, Carl put his hand inside the shoe. This behavior was blocked once instruction began. Carl struggled with the first two steps of the chain. He was using the wrong loop to weave the overhand knot, resulting in the laces coming undone. After a number of sessions at step 5, we conducted one session with physical assistance on the first attempt of each trial. During these trials, Carl was physically and verbally guided to choose the correct loop with which to make the overhand knot. After these trials, Carl progressed through the remaining steps of the chain. Carl obtained mastery of the chain in 131 trials, retained the chain after one week break, and required six sessions to learn to generalize the behavior a shoe he was wearing.

Leiliste

Leiliste's put the end of one of the laces into the shoe during baseline. When this behavior intermittently appeared during backward chaining the response was blocked. Leiliste

initially struggled with the fifth step, exhibiting behavior similar to Carl's, but learned this step without the need for an adjunctive procedure. Leiliste required 102 trials to achieve mastery of the chain, retained the chain after one week, and also needed six sessions to learn to generalize shoe tying to a shoe she was wearing. Lastly, Leiliste began to find the video aversive during the generalization phase (i.e. refusing to watch the video or sit in the chair) and assistance was provided after the first attempt to complete the chain. Even so, assistance was only provided on two out of six generalization trials.

Artico

During baseline, Artico grabbed the laces and pulled them apart until they came undone. Artico stopped engaging in this behavior when instruction was initiated. Artico had the most trouble with the third step, requiring 30 trials to master that step. Artico was able to master the full shoe tying chain in 91 trials, only retained four out of six steps 9 days later (extended due to illness), and required 14 sessions to generalization shoe tying to a shoe he was wearing.

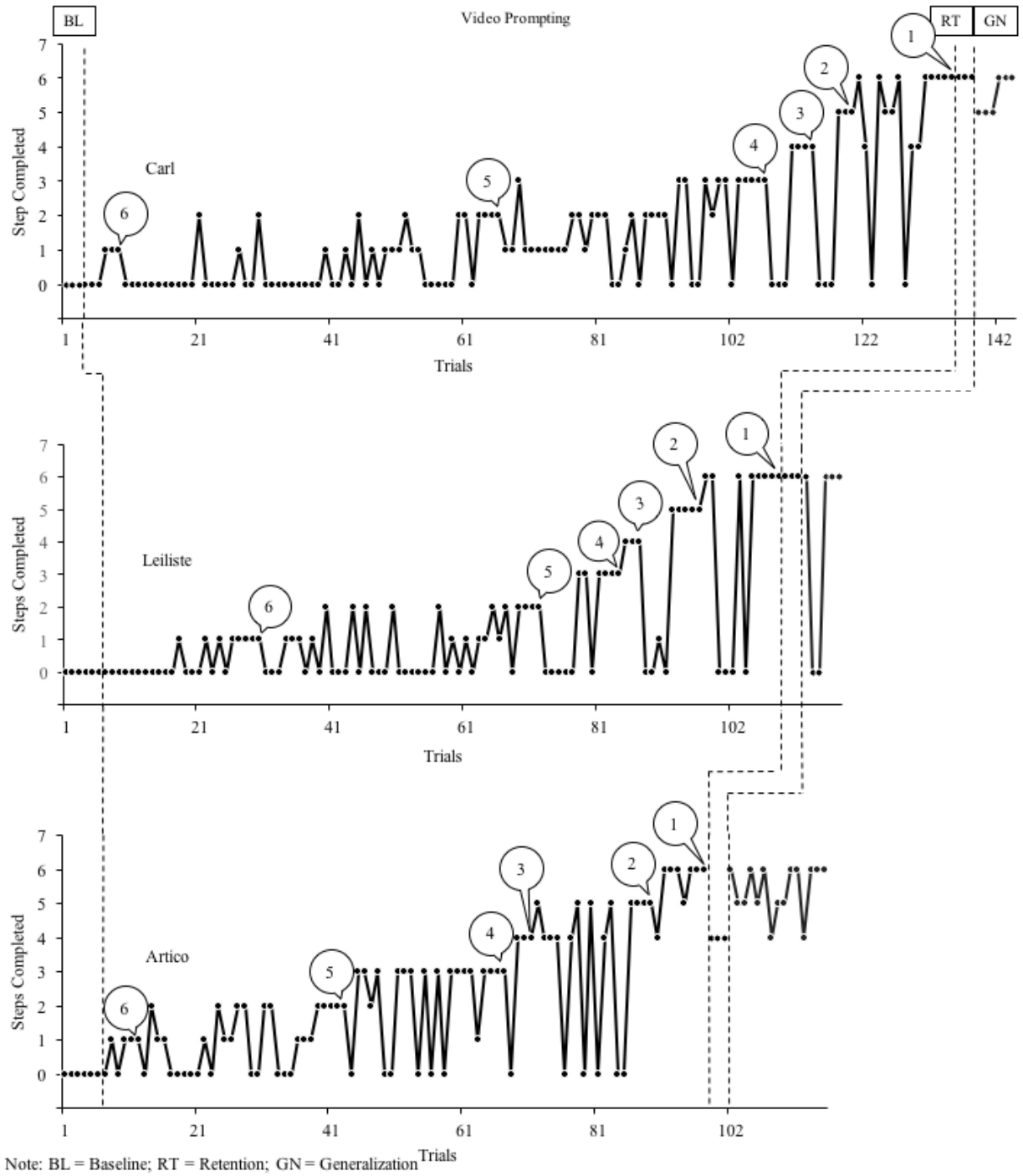

Figure 1. Graphical representation of participants' performance. Circles indicate step mastery progress.

CHAPTER 6: DISCUSSION

Ease of use, accessibility, and practicality are some of the putative benefits that VBIs are intended to provide practitioners in teaching children with ASD functional life and social skills (Rayner et al., 2009). This study extends the limited existing literature examining VBIs by integrating VBI with backward chaining as part of an instructional program to teach children with ASD a complex self-care skill. Previous research supports the idea that VBIs are effective in the acquisition of various skills for individuals with intellectual disabilities (Aykut, Dagseven Emecen, Dayi, & Karasu,2014; Norman et al., 2001) and individuals with ASD (Bellini & Akullian, 2007; Moore et al., 2013; Tereshko et al., 2010; Rayner et al., 2009; Shrestha et al., 2013). Similarly, this study's treatment package was found to be effective in skill acquisition for all participants. While effective, judging by the number of trials that required physical and verbal assistance, our results support those of Rayner (2011) in that video model exposure alone was not sufficient. The majority of the trials for the more difficult steps that were completed involved both physical and verbal assistance before the participant could complete the step on their own. Participant progress began relatively slow, but increased steadily as the first few steps were mastered. This may be due to the child having to not only learn how to perform the step, but also having to learn how to hold and coordinate the laces independently. This was particularly salient with our first participant, Carl, forcing us to incorporate the use of pipe cleaners in the procedure to keep the laces together. This change in procedure didn't occur until after Carl had completed a number of sessions, which may explain why it took him so long to master the first few steps.

The other two participants, Leiliste and Artico, progressed through the video-prompting phase with relative ease. Artico required the fewest trials to master the chain, but only retained four out of six steps and required more generalization trials than his peers. The failure to retain

steps one and two was also observed during Carl's retention phase, but he was able to self-correct before moving on. Being that steps one and two were fairly easy to learn, they may also be easily forgotten. We hypothesized that the fifth step chain would be the most difficult and require the most trials to learn. This hypothesis was confirmed across participants, requiring an average of 44 trials to master the chain. This single step represents 34 to 56 percent of total training trials across participants. This chain may have been difficult due to the participant having to coordinate both the direction in which the loops are crossed, as well as which loop needs to be pulled through the hole to make the overhand knot. Future studies may want to take into account the child's need for pre-requisite skills such as holding the laces independently as well as the difficulty of different steps prior to treatment.

As stated before, least-to-most prompting and blocking procedures were also used in this study. The least-to-most prompting procedures were mainly used on the third attempt. During this attempt, the child would receive verbal prompts first and then eventually full physical assistance if needed. Blocking procedures were implemented for inappropriate behaviors that were being repeatedly performed. These procedures have been used in past research on VBIs to assist with skill acquisition (Moore et al., 2013; Tereshko et al., 2010; Shukla-Mehta, Miller, & Callahan, 2010).

Limitations

As stated previously, many of the trials involved both physical and verbal assistance before the participant could complete the step on their own. Faster skill acquisition may have been achieved by providing least-to-most prompting on the first attempt. This is more so a limitation of this study's heavy reliance on the video by itself than a limitation of VBI in general. Providing the child with two attempts to complete the step using just video-prompting before

providing assistance may have proved to only hinder step acquisition. The choice to begin teaching with the shoe on a table rather than on the child's foot may be another limitation. Skill acquisition started on the table as a way of introducing the child to the task, as well as removing any behavioral barriers attributed to the child's rejection of the novel shoe on their foot. However, this may not be practical for practitioners because it extends the duration of the intervention. Rather than teaching the chain on a table and then generalizing to their foot, participants could have begun with the shoe on their foot. This would've eliminated the need for a generalization procedure or allowed time for generalization across settings. There were also some slight problems with skill generalization. The retention period of one week was also fairly brief compared to that of other studies (Rayner, 2011; Shrestha et al., 2013). A longer retention period of multiple probes may have provided more insight into the durability of the newly learned skill. Lastly, due to study coordination issues, Artico and Leiliste finished their baseline phases with the same number of trials. However, it is worth noting that there was no evidence that the participants were gaining shoe tying skills outside the study.

Future Directions

While this study provides additional support for the use of video-based interventions, future research may want to consider a number of factors. One factor that future research should consider is the examination of integrating video-based interventions as elements of comprehensive interventions for children with ASD as they may not be sufficient alone to promote skill acquisition (Rayner et al., 2009). A number of other factors should also be considered such as the durability of the skill as well as comparing the effectiveness of different components of VBIs. There are still a lot of unanswered questions regarding the effectiveness of

varying features such as point-of-view, self or other model, video length, length of retention period, etc. (Rayner et al., 2009).

This study's main goal was to determine the effectiveness of video prompting combined backwards chaining, for functional skill acquisition in children with ASD. The target behavior of shoe tying was broken down and taught in six different steps, starting with the last step. Participant progress was recorded across four different intervention phases (baseline, video prompting, retention, and generalization). In regards to studies that have examined VBIs combined with backward chaining, the research is limited (e.g., Cannella-Malone et al., 2006). Our hypothesis was confirmed that the treatment package, in general, would be effective for acquisition of the target behavior. The participants were also able to reliably demonstrate retention of the acquired behavior. While there are a number of considerations that should be taken into account by both researchers and practitioners prior to attempting this type of intervention, the results found in this study support its use for children with mild-to-moderate ASD.

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APPENDIX A: IMITATIONS DISORDERS EVALUATION SCALE (MODIFIED)

Imitations Disorders Evaluation Scale

IDE scale item	0	1	2	3	4
1 Ability to follow objects with eyes.					
2 Does not Imitate gestures					
3 Does not imitate actions with objects					
4 Gestural imitations are unusual or atypical					
5 Imitation is variable					

Table 1: Representation of the IDE scale used in this study.

Examples of imitation situations used in direct observation (Malvy et al., 1999)

Item 1: Child must follow the examiner with their eyes while he/she moves around the room

Item 2: Hand gestures such as clapping hands, waving bye-bye, touching nose.

Item 3: Fine motor skills imitation such as picking up small objects and putting a string through a hole.

Item 4: Gesture imitation with an object (i.e. a toy)

Item 5: Child will begin an action and stop (i.e. action discrimination)

APPENDIX B: INSTITUTIONAL REVIEW BOARD APPROVAL

ACTION ON PROTOCOL APPROVAL REQUEST

Institutional Review Board
Dr. Dennis Landin, Chair
130 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
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irb@lsu.edu | lsu.edu/irb

TO: George Noell
Psychology

FROM: Dennis Landin
Chair, Institutional Review Board

DATE: July 14, 2016

RE: **IRB#** 3745

TITLE: Video Based Intervention and Backward Chaining: Teaching Children with Autism Functional Behaviors

New Protocol/Modification/Continuation: New Protocol

Review type: Full ___ Expedited _X_ **Review date:** 6/29/2016

Risk Factor: Minimal ___X___ Uncertain _____ Greater Than Minimal_____

Approved_____X_____ **Disapproved**_____

Approval Date: 7/13/2016 **Approval Expiration Date:** 7/12/2017

Re-review frequency: (annual unless otherwise stated)

Number of subjects approved: 4

LSU Proposal Number (if applicable)**:** ____

Protocol Matches Scope of Work in Grant proposal: (if applicable)

By: Dennis Landin, Chairman _____

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. **SPECIAL NOTE: When emailing more than one recipient, make sure you use bcc.**

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

VITA

Philip Ross Richard III, a native of Lafayette, Louisiana, received his bachelor's degree at the University of Louisiana at Lafayette in 2014. Thereafter, he was accepted into graduate school in the Department of Psychology at Louisiana State University. He is a candidate to receive his Master's in August 2017 and plans to continue his program in order to receive his doctorate.