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Evaluating the Efficacy of Video Self-Modeling for Remediating Dysgraphia in Children with Autism Spectrum Disorders

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Abstract

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MA, University of Houston -Clear Lake, 2009

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

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Abstract

Writing is essential to human interaction. When handwriting is illegible, communication may be negatively impacted. A severe deficit in handwriting is known as dysgraphia, a problem frequently associated with autism spectrum disorders (ASD). Video self-modeling (VSM) has been effective for children with ASD in the strengthening of social skills, verbalizations, and daily living skills. However, there remains a gap in the literature regarding the use of VSM for the treatment of dysgraphia in children with ASD. Because VSM has demonstrated success in the acquisition of many types of skills, it may be similarly effective for remediating dysgraphia in children with ASD. Utilizing a behavioral perspective, this study sought to determine if VSM is an effective treatment for improving handwriting legibility and proficiency. This study analyzed secondary data collected by a day treatment center (DTC) specializing in the care of children with ASD. Data indicated that after establishing a baseline level of behavior for writing simple words, the DTC staff administered the VSM treatment and rated the legibility of the participants' responses based on the Woodcock-Johnson III Tests of Achievement (WJ-III) Handwriting Legibility Scale. Raw score differences between baseline and treatment phases were recorded and analyzed. A pretest/ posttest evaluation based on scores obtained from the Handwriting Proficiency Screening Questionnaire (HPSQ) and Handwriting Proficiency Screening Questionnaire for Children (HPSQ-C) determined changes in handwriting proficiency. These findings provide an important contribution to the existing literature, and they enhance social change initiatives through strengthening the communication skills of individuals with ASD.

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Dedication

I dedicate this research to my friends and family who have offered tireless support and encouragement. You have always known when to push me harder, when to give me space to work, and when to make me leave the office for a breath of fresh air. All three were equally important and I am immensely grateful.

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Chapter 1: Introduction to the Study

Introduction

Children with autism spectrum disorders (ASD) often present with special challenges in the attainment of basic skills that are needed to be successful throughout their lifetimes. An example of this type of challenge is handwriting, which can be particularly difficult for these children. The inability to write legibly, given age and intellectual level, is a disorder known as dysgraphia (Guerrini et al., 2015). Dysgraphia may present as problems with the appearance of handwriting (legibility) or the ease of writing (proficiency), but often both factors are problematic (Guerrini et al., 2015). Fuentes, Motofsky, and Bastian (2009) noted that many children with ASD have a weakness in handwriting, which can lead to problems with communication, school performance, and self-esteem. Video self-modeling (VSM) is a cognitive-behavioral treatment modality that has demonstrated success as a treatment for children with ASD in cultivating social interactions, increasing the frequency of verbalizations, and improving daily living skills.

This chapter introduces a background of relevant research before explaining how the present study aimed to fill a gap in the literature regarding the treatment of dysgraphia in children with ASD. The focus of the research is explored. This is followed by a description of the variables, as well as the research questions and hypotheses. The theoretical background of this study is explained, leading into a brief overview of

methodology. Limitations and delimitations of the study will be addressed. The chapter concludes with an analysis of the implications for positive social change.

Background

Research has demonstrated that VSM is an effective treatment for improving social skills (Boudreau & Harvey, 2013; Victor, Little, & Akin-Little, 2011), increasing verbalizations (Wert & Neisworth, 2003), and boosting daily living skills (Bellini & Akullian, 2007; Lasater & Brady, 1995) in children with ASD. VSM is a cognitive behavioral treatment modality in which a video recording is created and edited to show the subject accurately performing a target behavior. The video is then used as a teaching tool to help the subject actually acquire that target behavior (Buggey, 2007). By editing the video to show the subject independently performing the target behavior, a perception of self-efficacy develops as the subject watches the video, increasing the likelihood that the behavior will occur independently (Bellini & Akullian, 2007; Gelbar, Anderson, McCarthy, & Buggey, 2012).

A Brief History on the Successful Use of VSM

Previous research supports the use of VSM as an effective treatment for a variety of different skills. In her doctoral dissertation, Miller (2013) found that, in conjunction with other techniques (i.e. direct teaching methods), a VSM approach significantly improved opinion-writing skills in third-grade students with learning disabilities. Bellini & Akullian (2007) conducted a meta-analysis of video modeling (VM) and VSM, finding that both techniques were highly effective methods of helping children with ASD acquire a variety of skills. The authors wrote of the successful implementation of VSM for

improving daily living skills (i.e., face and hand washing), social skills (i.e., conversational skills), and community skills (i.e., purchasing items). Similarly, Gelbar et al. (2012) described how VSM has shown effectiveness across multiple behaviors, including the reduction of problematic behaviors and increase of socially desirable behaviors. Ayala and O'Connor (2013) used a multiple baseline approach to determine the efficacy of a VSM intervention for improving reading skills among typically developing first-grade students. The VSM treatment approach was found to be effective for all students and 70% maintained their progress weeks later.

VSM for Improving Social Interactions

Boudreau and Harvey (2013) utilized a multiple baseline across participants design to demonstrate that VSM is an effective strategy for increasing social initiation in children with ASD. Three participants were shown a video of themselves engaging in age-appropriate interactions with a group of peers. All participants showed an increase in social initiations on the playground after watching the video. Two of the three participants maintained an elevation in the frequency of these skills during follow-up. Similarly, Victor et al. (2011) found that VSM increased the rate of social initiations. This effect was immediate, and the participants maintained their gains throughout a maintenance phase.

Buggey et al. (2011) found success when using VSM with four-year-old children who had been previously diagnosed with Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS) to increase social initiations, but had more difficulty with the one participant who was only three years old at the time of the intervention.

Moreover, Buggey (2012) had similar difficulty increasing social interactions in another study with three-year-old participants (Hoomes, Sherberger, & Williams, 2011). The authors concluded that VSM might not be as effective for younger children.

VSM for Increasing Verbalizations

Wert and Neisworth (2003) used a multiple baseline across participants design to determine if preschool children with ASD would increase their rate of spontaneous requesting following the introduction of a VSM treatment program. Three of the four participants showed immediate improvement after watching the video. The participant who was the least interested in watching the self-modeled video showed the greatest delay before improving, but still improved significantly. As observed during the maintenance phase, participants maintained their behaviors for a minimum of 2-6 weeks following the removal of the video.

VSM for Strengthening Daily Living Skills

In their meta-analysis, Bellini and Akullian (2007) discussed how video modeling and VSM have been used successfully to strengthen daily living skills. By utilizing a multiple baseline across tasks design, Lasater and Brady (1995) demonstrated the efficacy of VSM procedures for increasing task fluency and independent initiations. The researchers tracked the task completion skills of two adolescent males diagnosed with ASD. Data were collected for the number of steps of each task, length of completion, and frequency of task-interrupting behavior. As part of a treatment package that also included self-assessment and behavioral rehearsal, VSM was found to be an effective component of improving the efficiency of daily living skills in individuals with ASD.

Filling the Gap: VSM for Treating Dysgraphia in Children with ASD

Prater, Carter, Hitchcock, and Dowrick, (2012) conducted a literature review to examine the usefulness of VSM for academic performance, noting that the majority of VSM research has centered on social and verbal skills, with a paucity of information regarding the use of VSM to improve academic performance. Though Buggey (2007) discussed the value of VSM for the acquisition of a variety of practical skills in children with ASD, to date no research has explored the potential utility of a VSM approach for the treatment of dysgraphia in children with ASD. Remediating dysgraphia in children with ASD should strengthen communication, improve school performance, and increase self-esteem.

Problem Statement

Children with ASD often have difficulty with handwriting skills. Research has indicated that handwriting can negatively affect communication, school performance, and self-esteem (Fuentes, Motofsky, &Bastian, 2009). Therefore, an improvement in handwriting legibility and proficiency would likely result in better communication skills, an enhancement in school performance, and increased self-esteem. VSM treatment has demonstrated utility for increasing the frequency of social initiations, improving verbalizations, and strengthening daily living skills. Despite the importance of handwriting skills and the proven effectiveness of VSM, to date there has been no published research examining the relationship between VSM and dysgraphia in children with ASD.

Purpose of the Study

This research was quantitative in nature. The aim was to conduct analyses of secondary data to identify differences in the legibility and proficiency of handwriting skills following VSM treatment in a sample of children with ASD. The independent variable was the video self-modeling treatment. The primary dependent variable was handwriting legibility based on observer ratings. The secondary dependent variables were related to handwriting proficiency based on staff and participant ratings.

Research Questions and Hypotheses

Treatment Phase

- Are significant differences evident in the legibility of handwriting when utilizing a VSM treatment approach**?**

The treatment phase data will be used to determine if hypotheses 1, 2, and 3 are accepted.

H_a1: The participant will demonstrate an increase of 10 points or more when writing his or her name, as measured by daily target probes.

H_01: The participant will demonstrate an increase of less than 10 points when writing his or her name, as measured by daily target probes.

H_a2: The participant will demonstrate an increase of 10 points or more when writing the word “cat,” as measured by daily target probes.

H_02: The participant will demonstrate an increase of less than 10 points when writing the word “cat,” as measured by daily target probes.

H_a3: The participant will demonstrate an increase of 10 points or more when writing the word “apple,” as measured by daily target probes.

$H_0$3: The participant will demonstrate an increase of less than 10 points when writing the word “apple,” as measured by daily target probes.

Maintenance Phase

- Are significant differences evident in the legibility of handwriting four weeks after the conclusion of a VSM treatment program?

The maintenance phase data will be used to determine if hypotheses 4, 5, and 6 are accepted.

H_a4: The participant will maintain an increase of at least 5 points when writing his or her name, as measured by daily target probes.

$H_0$4:The participant will not maintain an increase of at least 5 points when writing his or her name, as measured by daily target probes.

H_a5:The participant will maintain an increase of at least 5 points when writing the word “cat”, as measured by daily target probes.

$H_0$5:The participant will not maintain an increase of at least 5 points when writing the word “cat”, as measured by daily target probes.

H_a6:The participant will maintain an increase of at least 5 points when writing the word “apple”, as measured by daily target probes.

$H_0$6:The participant will not maintain an increase of at least 5 points when writing the word “apple”, as measured by daily target probes.

Pretest/ Posttest Evaluation

- Are significant differences evident in the proficiency of handwriting following a VSM treatment approach?

The pretest/posttest data will be used to determine if hypotheses 7 and 8 are accepted.

H_a7: The participant's score will improve by 6 points or more from pretest to posttest based on therapist ratings on the HSPQ.

$H_0 7$: The participant's score will not improve by at least 6 points from pretest to posttest based on therapist ratings on the HSPQ.

H_a8: The participant's self-report score will improve by 6 points or more from pretest to posttest on the HSPQ-C.

$H_0 8$: The participant's self-report score will not improve by at least 6 points from pretest to posttest on the HSPQ-C.

Social Validity

Therapists. Do therapists believe that video self-modeling is a socially acceptable treatment approach for dysgraphia in children with ASD within a day treatment center setting?

H_a9: The average rating of the therapist's modified BIRS will be a 4 or above indicating that he or she believes that VSM is a socially acceptable treatment approach for dysgraphia in children with ASD within a day treatment center setting?

$H_0 9$: The average rating of the therapist's modified BIRS will not be a 4 or above indicating that he or she believes VSM is not a socially acceptable treatment approach for dysgraphia in children with ASD within a day treatment center setting?

Participants. Do participants believe that video self-modeling is a socially acceptable treatment approach for dysgraphia within a day treatment center setting?

H_a10: The average rating of the participants' modified CIRP will be 4 or above indicating that he or she believes that VSM is a socially acceptable treatment approach for dysgraphia within a day treatment center setting.

$H_0$10: The average rating of the participants' modified CIRP will not be 4 or above indicating that he or she does not believe that VSM is a socially acceptable treatment approach for dysgraphia within a day treatment center setting.

Theoretical Framework

Bandura's (1969) social learning theory offers a useful theoretical framework for this study because VSM relates to the concept of observational learning. By observing the successful demonstration of a task, the viewer learns to perform the task effectively. Research has demonstrated that greater parity between the video model and the observer increases the probability that the behavior will be imitated (Buggey, 2007). The self is the highest level of similarity for a model, further lending credence to the potential efficacy of VSM. Additionally, Bandura (1997) believed that watching oneself successfully perform a task promotes feelings of self-efficacy increasing the potential for effective skill acquisition.

Skinner's operant behavior model (Wolf, Risley, & Mees, 1963) also contributes to this research. Reinforcement is often associated with successful skill completion, thus increasing the likelihood that the behavior will be demonstrated again (Hitchcock, Dowrick, & Prater, 2003). Moreover, as the participants increase the frequency with which they exhibit the target behavior, natural reinforcers begin to take effect.

Communication is strengthened, school performance is improved, and self-esteem is heightened, further contributing to an increase in the frequency of the behavior.

Nature of the Study

The nature of this study was quantitative. Data were originally collected by therapists at a day treatment center (DTC) specializing in the treatment of children with ASD. Data were subsequently provided to the student researcher for secondary analyses. Similar to previous VSM research, a single subject multiple baseline across participant approach was operated by DTC staff. Therapists from the DTC utilized the *Handwriting Legibility Scale* from the *WJ-III ACH* to assign a numeric value between 1 and 100 to the legibility of the participant's handwriting. A pretest/ posttest measure (*HSPQ* and *HSPQ-C*) was used to determine handwriting proficiency. Social validity ratings were obtained from the *BIRS* and the *CIRP*.

Operational Definitions

Discriminative stimuli (SD):, is defined as a verbal instruction given to the participants by the DTC therapists (i.e., "Write your name", "write cat," "write apple").

Dysgraphia: is defined as the inability to write legibly.

Handwriting legibility: is defined as legibly printing each target word using a pencil on lined handwriting paper.

Handwriting proficiency: is defined as the participant's handwriting readability, ease of writing, frequency of erasing, and overall satisfaction with the writing process.

*Handwriting skills (*also referred to as the *target behavior*): are defined as the participant's ability to write the target words (his or her name, "cat," and "apple") based on a verbal instruction.

A *prompt:* is defined as any assistance (verbal or physical) given to participants by DTC therapists.

Video self-modeling: is defined as the condition in which a video is recorded and edited to show the participant displaying the target behavior. The video will then be shown to the participant at the beginning of each treatment session.

Scope and Delimitations

This study focused on school-age children with ASD exhibiting severe handwriting deficits. Because all participants came from the same DTC, the generalizability of the results may be limited; however, this method was reportedly chosen by DTC staff to allow for a greater consistency in implementation. In addition to the availability of participants to the DTC, children with ASD were also chosen as the target population because ASD is a growing concern in today's world. Parents often express concern for how to best prepare their children for school and having good handwriting skills is a part of that process. Similarly, children (as opposed to adults) were used as the target population for this reason. While handwriting is important at any age, it can be especially relevant to children due to the demands placed on them within an academic setting. If a child cannot write legibly or proficiently, school can be very difficult.

Limitations

One limitation of this research was that the participants all shared some similarities. Each participant was similar in age (between 7 and 9 years old). Each participant also attended the same day treatment center. Because the cost of daily treatment at the DTC is high, the SES for each participant is moderate to high. Participants also had the same diagnoses, and similar skill levels were necessary to qualify for participation.

A second potential limitation of this research is that the research had such a highly specified focus. The focus of the research is on writing three particular words. Though the participants may be able to acquire the skills necessary to produce these three words, it is uncertain whether this will allow for a full generalization of handwriting skills. If this study demonstrates the success of VSM in the skill acquisition of writing his or her name, the word "cat," and the word "apple," further research evaluating the utility of VSM for dysgraphia could prove valuable.

This study utilized the WJ-III ACH Handwriting Legibility Scale, which does not have numerical validity data. Reliability data is high, but numerical validity data were unavailable. Similarly, the HSPQ and HSPQ-C are relatively new forms that had not yet been published prior to the writing of this proposal. According to Rosenblum and Gafni-Lachter (2015), the HSPQ and HSPQ-C have demonstrated high internal consistency, concurrent validity, and construct validity; however, this information has not yet been confirmed by independent research.

Additionally, it is important to understand that factors beyond the research site's control could potentially influence results. Because handwriting is such a ubiquitous activity, it is possible that the research could be tainted by outside practice. To limit the possibility of this confounding variable, DTC staff were instructed to not conduct any handwriting activities outside of the scope of VSM treatment. However, it is possible that parents or family members of participants encouraged or practiced handwriting skills at home.

Significance

This study offers an original contribution to the scientific body of knowledge by adding to the limited information available related to the use of VSM in the treatment of dysgraphia for children with ASD. A review of the literature demonstrated that VSM has shown to be an effective, evidence-based practice. Specifically, VSM has shown high efficacy in increasing verbalizations (Wert & Neisworth, 2003), promoting social skills (Boudreau & Harvey, 2013; Gelbar et al., 2012), and improving daily living skills in children with ASD. An area that is less saturated is the use of VSM for treating academic deficits. Ayala and O'Connor (2013) effectively utilized a VSM treatment plan for children with ASD in the treatment of reading disabilities. Montgomerie, Little, and Akin-Little (2014) demonstrated the success of VSM for improving oral reading fluency in typically developing children in New Zealand. Additionally, Miller (2013) demonstrated how VSM could be used to improve the writing skills of children with learning disabilities. However, to date there appears to be no published research on the application of a VSM treatment approach for dysgraphia in children with ASD.

With the prevalence of ASD increasing in recent years, now affecting an estimated 1 in 68 children (Christensen et al., 2016), it is imperative to find the most effective ways to enhance skill acquisition in these children. If VSM is proven to be an effective method for remediating dysgraphia in children with ASD, these findings could be immensely beneficial. Cellular phones with recording devices are now readily accessible, even in impoverished areas. Administering a VSM procedure is relatively quick and simple, meaning that facilities around the world have the potential to implement this technique. If, as hypothesized, VSM proves to be an effective teaching tool for children with ASD, global implementation within treatment centers could prove to be a realistic goal. Better handwriting skills in children with ASD could lead to a global improvement of communication, enhanced educational experiences, and a rise in positive self-esteem.

Summary

Children with ASD often exhibit deficits in handwriting. Both legibility and proficiency can be negatively impacted. VSM treatment has been shown to be an effective treatment method for improving social initiations, increasing verbalizations, and strengthening daily living skills in children with ASD. Therefore, it is plausible that VSM will be similarly effective for remediating dysgraphia within this population. This study conducted secondary analyses of data initially collected by DTC staff during the normal course of treatment. A quantitative, multiple baseline across participants approach was implemented by DTC staff to track changes that occurred during and after treatment. The WJ-III ACH Handwriting Legibility Scale was used to determine

legibility and the HSPQ and HSPQ-C was used as a pretest/posttest measure to determine proficiency. The BIRS and the CIRP were used to measure the social validity of the VSM treatment. Positive findings stemming from this research have the potential to lead to great social benefits, such as an improvement in the way children with ASD receive treatment. Chapter 2 sets forth these concepts in greater depth, providing a more detailed look at dysgraphia and VSM and examining these variables in relation to children with ASD.

Chapter 2: Literature Review

Introduction

This chapter includes a review of the literature on video self-modeling (VSM) with a specific focus on the treatment of children with autism spectrum disorder(ASD). The chapter begins with an overview of ASD, including prevalence rates, relevant symptomology, and a description of applied behavioral analysis (ABA), the current treatment of choice for ASD. Next, the process of handwriting is examined in detail, including what it is, why it is important, and how it can best be assessed. Then video modeling (VM) is explored, followed by a more in-depth review of VSM as a treatment for a variety of disorders. This leads into a discussion of the theoretical framework relevant to VM, namely Albert Bandura's social learning theory. After this follows a discussion about how the use of VSM as a treatment for dysgraphia in children with ASD fulfills a gap in the current literature.

Literature Search Strategies

Prior to implementing the study, a comprehensive review of the literature was conducted by inputting the key search terms *video modeling*, *video self-modeling*, *dysgraphia*, *behavioral treatment*, *applied behavior analysis*, *legibility scale*, *autism spectrum disorder*, *handwriting*, *social learning theory*, *self-efficacy*, *Bandura*, and multiple combinations of these terms, into search engines, including PsycINFO, PubMed, EBSCO host, ProQuest, and Google Scholar. In addition to relevant peer-reviewed articles, books and past doctoral dissertations were included as supplemental information. References contained within these writings were used to continue researching the topic.

The research was considered exhausted when the findings in the articles became redundant and the same key authors and studies were cited throughout articles.

Many articles were found identifying treatment approaches aimed at remediating behavioral concerns for individuals with Autism. Additionally, many of these articles focused specifically on VM and VSM approaches. The specific nature of handwriting deficits was frequently addressed, as was the importance of promoting effective handwriting skills. Harder to find, however, was a consistently effective method for assessing handwriting deficits and tracking progress in this area. This subject will be discussed in more depth later in the chapter.

Miller (2013) measured the effectiveness of a VSM program to improve the writing skills of third-grade students with learning disorders. Several other researchers applied VSM strategies for remediating behavioral deficits in children with ASD. However, the aforementioned search strategies failed to uncover any published literature on the use of VSM for the treatment of dysgraphia in children with ASD.

Autism Spectrum Disorder

Overview

ASD is a neurodevelopmental disorder that begins in early childhood (APA, 2013). According to the Center for Disease Control, prevalence rates are currently at approximately 1 in 68 births (Center for Disease Control [CDC], 2015), while the Diagnostic and Statistical Manual of Mental Disorders – 5th Edition (DSM-5) (APA, 2013), lists the prevalence rate at approximately 1% of the population (APA, 2013). Regardless of which figure is more accurate, most people would agree that the prevalence

of ASD is distressingly high. This contributes to an understanding of why autism research is so plentiful. A search on Google Scholar using the term *autism* yielded nearly 700,000 results. A large quantity of research is centered on autism, and it continues to permeate popular culture, as well (Smith, Ellenberg, Bell, & Rubin, 2008). Few days pass where one does not hear a story on a news program or see a puzzle shaped pin or bumper sticker attempting to raise awareness for this disorder. It is clear that ASD is an important social concern, but beyond that, what is it exactly?

Symptomology

Autism spectrum disorder (ASD) is so named because of the way that an individual's symptoms, often thought of as behavioral excesses and deficits, fall on a spectrum. This means that some individuals may present with a significant level of multiple symptoms and a lower IQ, thus being classified as *severe* while another person may have only a few mild symptoms and a higher IQ, earning a *mild* classification.

As defined by the DSM-5 (APA, 2013), ASD is characterized by persistent deficits in social communication and social interaction across multiple contexts. This may include deficits in social-emotional reciprocity, such as difficulty interacting with others in a back-and-forth flowing manner; a failure to initiate social contact; or a limited ability to share emotions and interests. Deficits in nonverbal communications are often present, including a lack of appropriate facial expression, sporadic eye contact, and unusual body language.

Individuals with ASD often have a limited interest in peers. Children may not be adept at engaging in make-believe play. It may be more difficult for someone with ASD

to participate appropriately during social interactions. Frequently, individuals display a restricted and repetitive pattern of behaviors, interests, and activities. Individuals with ASD may be particularly resistant to change. They may engage in repetitive behaviors such as hand flapping, echolalia, or lining up toys. Often, sensory issues are present, and the individual will experience sounds, tastes, and sights as significantly enhanced (APA, 2013).

To meet the DSM-5 criteria (APA, 2013), these behaviors must have been present during the early developmental period and must cause the individual significant impairment in functioning. Andersen, Skogli, Hovik, Egeland, and Oie (2015) noted that ASD is associated with an impairment in executive functioning that involves planning ahead and organizational abilities. This executive functioning deficit may contribute to the lack of flexibility and inability to shift behavior easily that is often associated with the disorder.

Applied Behavioral Treatment for Autism Spectrum Disorder

While B.F. Skinner, a prominent American psychologist who rose to fame with his perspective on behaviorism, played an integral role in the development of behavioral theory (Wolf et al., 1963), few would dispute the important role that O. Ivar Lovaas, another important behavioral psychologist, played in applying the principles of Skinner's behavior modification to the treatment of ASD in children (Eldevik et al., 2010; Rogers & Vismara, 2008). In 1970, Lovaas began applying empirical methods of research to rate the progress of children with ASD following intensive behavior modification treatment (Lovaas, 1987). Lovaas examined two groups of young children (less than 40 months of

age at intake) who had been diagnosed with ASD. One group was given a minimum of 40 hours of one-to-one treatment per week. The second group received significantly less treatment consisting of a maximum of 10 hours per week. Results showed that 47% of the children who received at least 40 hours per week of treatment were able to reach normal levels of cognitive functioning and successfully mainstream into a regular classroom. Another 40% still had some degree of cognitive delay and had to be placed in classes for language delays, while the remaining 10% did not make sufficient gains to be removed from the designated classroom for autistic students. Contrast those findings with results from the group who received significantly less treatment. In this group, only 2% of the children were able to mainstream to a normal classroom, while 53% were placed in language delayed classes, and 53% were considered *severely retarded* and remained in the classroom for autistic students (Lovaas, 1987).

Due to the success of this seminal study, the treatment of ASD has moved primarily toward behavior modification, now often referred to as Applied Behavior Analysis (ABA) treatment. Whether in schools, day treatment centers, or home-based programs, intensive ABA has become the treatment of choice for ASD (Callahan et al., 2010; Leaf et al., 2015). Given the plethora of treatments for ASD lacking sufficient empirical evidence of efficacy, cultivating an evidence-based treatment for ASD has been proven valuable (Simpson, 2001).

Handwriting and ASD

Overview

The DSM-5 (APA, 2013) includes information regarding the prevalence of motor deficits in individuals with ASD. The ability to write is often problematic for children with ASD. Kushki, Chau, and Anagnosou (2011) defined handwriting as "the process of forming letters and symbols, generally on paper" (p. 1706). Fuentes, Motofsky, and Bastian (2009) addressed the difficulty that children with ASD often have in acquiring handwriting skills, noting that this weakness can contribute to problems in school, communication, and even self-esteem. Feder and Majnemer (2007) agreed with this assertion, adding that children with handwriting deficits often fall behind in school because approximately 31% - 60% of a student's day is spent engaging in writing tasks, such as note taking or completing assignments. The authors suggest that this significant academic deficit can contribute to self-esteem issues for children.

Moreover, Kushki et al. (2011) reported that fine motor difficulties are frequently associated with ASD, leading to problems with handwriting. Handwriting requires simultaneous processing of motor and cognitive demands. With practice, automaticity often develops. If, however, automaticity of motor and cognitive demands does not develop, expression of ideas may be impeded because the brain becomes more consumed with the production of handwriting rather than the expression itself (Kushki, 2011). This is problematic, because handwriting is still often required in schools to complete in-class work and exams (Rosenblum, 2013). Handwriting is often associated with functional skills for self-expression, communication, and recording of thoughts and experiences.

Handwriting is also important for personal communication, such as writing a quick note or signing a birthday card.

Poor handwriting can negatively affect a person as they enter adulthood and attempt to find jobs, as many employers still require hand-written job applications or necessitate other forms of writing during the hiring process. After specifically studying the ways that handwriting affects the hiring process, Roach and Bevill (1993) found that more than half of employers interviewed agreed that potential employees must be able to write legibly. Researchers also found that the quality of handwriting influenced perceptions about an applicant's level of motivation, laziness, and overall capability to complete a job (Roach & Bevill, 1993). While the increased use of computers makes handwriting in jobs less necessary in current society, handwriting legibility and proficiency remains important (Rosenblum, 2013). Without adequate handwriting skills, communication, academic functioning, and self-esteem can become problematic.

Dysgraphia

The inability to write legibly is a disorder known as dysgraphia (Guerrini, et al., 2015). Dysgraphia is somewhat of a difficult term. At a basic level, it breaks down to the root word "graphy," meaning to write, and the prefix "dys," meaning bad or difficult. Therefore, dysgraphia translates to difficult to write. A review of the literature shows that researchers frequently apply the term using ill-defined boundaries, some using it to describe an inability to write coherently and others relating it to drawing activities. The most widely used application, however, matches the one used in this research: difficulty

with forming and spacing letters on a page (Johnson et al., 2013; Mayes & Calhoun, 2007).

Johnson et al. (2013) discussed handwriting difficulties within the autism population using the term dysgraphia. Mayes and Calhoun (2007) found that approximately 50% of children with ASD have a comorbid diagnosis of dysgraphia. Further, Mayes and Calhoun noted that handwriting difficulties are among the most salient problems for children with autism within a classroom environment.

Handwriting Remediation

After establishing the importance of developing strong handwriting skills, Feder and Majnemer (2007) conducted an analysis on the effectiveness of handwriting intervention. It was noted that approximately 10-30% of school-aged children have significant difficulty with handwriting. The authors' first conclusion was that dysgraphia often does not improve without direct intervention. Second, they found that systematic handwriting treatment is effective. Several treatment types were studied, including handwriting instruction, occupational therapy services, and kinesthetic training, but efficacy rates comparing treatment types were not reported. The authors concluded that the best treatment is the one that is most applicable to the child.

Carlson, McLaughlin, Derby, and Blecher (2009) utilized a multiple baseline approach to teach young children with ASD to increase the legibility of individual letters using a direct instruction-based treatment program, Handwriting Without Tears. Using observers to judge writing quality before and after treatment, researchers found a significant improvement in handwriting legibility following the Handwriting Without

Tears program. Various treatment approaches have been shown to be effective for improving handwriting skills in children with and without developmental delays.

Assessing Handwriting

The Handwriting Proficiency Screening Questionnaire (HPSQ) and The Handwriting Proficiency Screening Questionnaire for Children (HPSQ-C).

Handwriting quality is correlated with various aspects of fine motor control including manual dexterity, grip, muscle tone, in-hand manipulation, movement isolation, grading, and time (Kushki et al., 2011). Though articles about the importance of handwriting quality are plentiful, there is a paucity of information explaining how to assess handwriting skills most accurately. An exploratory search led to the identification of a researcher in Israel who has frequently published in the area of handwriting. Rosenblum and Gafni-Lachter (2015) created the Handwriting Proficiency Screening Questionnaire (HPSQ), as well as the Handwriting Proficiency Screening Questionnaire for Children (HPSQ-C). The HPSQ is a 10 item rating scale that is filled out by an adult observer. The HSPQ-C is a 10 item self-report rating scale filled out by the target child. The *HSPQ* and the HSPQ-C both ask the respondent to indicate the level of readability for the target child's handwriting, as well as to rate issues related to handwriting proficiency such as erasing and satisfaction with the writing process. According to the authors, it is appropriate for use with children with moderate verbal communication skills, who can understand these types of questions and respond accurately (Rosenblum & Gafni-Lachter, 2015). An analysis of reliability and validity provided by the authors indicated that the HSPQ-C demonstrated good internal consistency (α =.77). Concurrent validity was also

established between the HSPQ and the HSPQ-C (r =.51, p < .001). Construct validity was confirmed using confirmatory factor analysis. Analysis showed that the HSPQ and the HSPQ-C distinguished between children with and without handwriting deficiencies (Rosenblum, 2008; Rosenblum & Gafni-Lachter, 2015).

Woodcock Johnson Tests of Achievement- 3rd Edition.

The *WJ-III ACH* is a standardized, nationally norm-referenced achievement test that is suitable for individuals age 2 through 90+. The *WJ-III ACH* contains the *Handwriting Legibility Scale,* which directly follows the *Writing Samples* subtest. Scores are calculated utilizing a numerical value between 0 and 100 to reflect the participant's handwriting abilities. A score of "0" indicates writing that is completely illegible, while a score of "100" indicates perfect, "artistic" adult-level handwriting (McGrew & Woodcock, 2001). The numerical value on the legibility scale is calculated based upon factors such as slant, spacing, size, horizontal alignment, letter formation, and line quality. Raters may also judge the writing as falling in one of three categories: "needs improvement," "satisfactory," or "excellent." The *WJ-III ACH* reported a median score of *.75* for 3rd grade respondents, indicating a high level of interrater reliability for the *Handwriting Legibility Scale*.

Video-Modeling

Video-modeling (VM) is a specific technique used within the umbrella of ABA treatment. VM takes its roots from the work of Albert Bandura. Learning through imitation, or modeling, is also referred to as vicarious learning, learning through

observation, and identifactory learning (Cullinan, Kauffman, & LaFleur, 1975). VM puts a modern spin on the principles of learning through observation by teaching the observer with a video recording. In order for VM to be an effective treatment method, participants must have access to some sort of video-playing devices; in recent years, cellular telephones have made this requirement very easy to meet. The participant must also have the ability and motivation to attend to the video throughout its duration (Lasater & Brady, 1995).

Previous Research on Video Modeling as a Treatment Approach

VM has been used for years to introduce novel skills and improve upon emergent abilities. Lange (1971) utilized a pretest-posttest design between two groups of student teachers to see if watching a video demonstration of effective teaching skills could increase knowledge of teaching abilities. Analysis of covariance showed that the teachers who watched a video depicting effective teaching skills performed better on the posttest than the teachers who were shown a neutral video unrelated to teaching skills. This study supported the utility of VM as a teaching tool.

More recently, D'Ateno, Mangiapanello, and Taylor (2003) used recordings of adults interacting in a positive social manner with one another to help improve upon social communication skills and play behavior in young children. Using a multiple baseline design, it was determined that the child's response rate increased by 92% after viewing the video and remained 22% higher during a generalization phase. Additionally, no external behavioral modifiers of reinforcement or punishment were used in

conjunction with the VM procedure, further indicating that VM was responsible for the increase in pro-social behavior.

Curlin (2015) utilized a single subject multiple baseline design to examine the impact of VM on the math achievement of typically developing high school students. A large effect size was found across all three students, though only one student reached the anticipated 80% percentage level of non-overlapping data points. VM had a positive impact on math performance for all participants. VM has also been used to successfully increase functional skills in children with ASD, such as purchasing behavior (Haring, Kennedy, Adams, & Pitts-Conway, 1987), using zippers (Norman, Collins, & Schuster, 2001), and sharing with others (Simpson, Langone, & Ayers, 2004).

Video Self-Modeling

VSM is a strength-based approach, meaning that it is based on promoting the strengths of the individual, rather than focusing on decreasing negative behaviors (Collier-Meek et al., 2012). VSM first appeared in the psychological world in the early 1970s (Buggey, 2012). VSM is highly similar to VM, except that it replaces the third-party subject in the recording with a recording of the individual performing the skill. That is, the person who is working toward mastering the skill is the one depicted in the video. Film editing offers multiple approaches for creating this type of video. If the skill is already in the individual's behavioral repertoire, but needs to be utilized more frequently, then the filming of the video may simply be a matter of recording the subject until they emit the behavior or somehow eliciting the desired response from the individual. This method is referred to as *positive self-review* (Collier-Meek et al., 2012).

If, however, the person is not yet able to perform the target behavior, then incremental occurrences of the behavior can be recorded and edited together to simulate a fluid demonstration of the target behavior, a technique known as "feedforward" VSM (Collier-Meek et al.). In either method, the film is edited so that the video depicts a positive recording of the person demonstrating the target behavior without any prompting or other distractions (Buggey, 2012). VSM, in summary, involves creating a video of the person demonstrating the target behavior, showing the person the video, and recording changes in the subsequent occurrence of the target behavior.

Video self-modeling has several advantages over other types of VM. First, there is evidence that the more similar a model is to the observer, the more likely it is that the viewer will repeat the behavior (Prater et al., 2012). Using oneself as a model provides unsurpassable similarity between viewer and observer. Second, video self-models can be created to display an exact demonstration of the target behavior. Whereas others may perform behaviors slightly differently in a modeling video, a self-model video is tailored specifically toward the person who is to be performing the behavior. This similarity can be helpful to the viewer, especially during the initial acquisition phase (Gelbar et al., 2012). Third, videos containing the self as a model often generate more interest, and thus increase attention, which also facilitates the learning process (Dowrick, 1999). Finally, using the self as a model can increase the individual's perception of self-efficacy for performing the target behavior (Bellini & Akullian, 2007).

Because of the ubiquity of handheld recording and video playing devices, including as a part of most cell phones, VSM is an evidence-based treatment approach

that can be implemented quite easily and inexpensively (Collier-Meek et al., 2012). Despite a prevalence of research extolling the value of VSM combined with the ease of procedural implementation, VSM is not as widely utilized as it could be. The reason for this may have to do with a lack of knowledge about the existence of the procedure, as well as the specifics of implementation (Collier-Meek et al.).

Previous Research on Video Self-Modeling as a Treatment Approach

Research on VSM began appearing in the early 1970s (Hitchcock et al., 2003). DeRoo and Haralson (1971) wrote about the successful use of VM for helping adults with special needs to increase work productivity. By having 12 young adult subjects (17-24 years old) view a video recording of themselves working, productivity increased significantly when compared to a control group. More impressively, the increased work productivity continued long after the cessation of the intervention.

Lasater and Brady (1995) implemented a VSM treatment package to increase task fluency with two developmentally disabled adolescent males. The researchers found improvement on not only the tasks specifically targeted, but also saw an increased generalization in task fluency across novel behaviors. Furthermore, the participants in this study were able to maintained these skills after the video training was removed.

Cihak, Wright, and Ayers (2010) used a VSM technique to increase task engagement across three children with high-functioning autism. This study was unique in that it offered handheld computer devices to each student to view videos of them successfully performing tasks. Using an ABAB design, it was determined that following

the VSM treatment phase, the children were more able to successfully self-monitor and self-regulate across multiple settings.

Finding further support for the effectiveness of VSM, Boudreau and Harvey (2013) studied three children with ASD to determine if a VSM program would increase recreational initiation with peers. Employing a multiple baseline design, researchers showed 6-7 minute videos to each child depicting clips of effective social initiations made by that child. After viewing the video, the children were moved to a playroom and the number of independent social initiations made by each child was recorded. Results showed that each child made significantly more social initiations after viewing the recorded segments, and that these results lasted through a maintenance phase that occurred 2 weeks post-intervention. Though motivation and attention was moderately high during the video, the author noted that a shorter video might have been more effective at holding the participants' attention.

Though the significant majority of research details the successful outcome of VSM, a complex reversal design of six children with Oppositional Defiant Disorder showed no objective advantage to utilizing a VSM strategy in conjunction with standard treatment; however, self-reports of aggressive behavior were lower following the VSM treatment condition (Clark et al., 1993). Other effective uses of VSM include decreasing noncompliant behavior (Creer & Miklich, 1970), reducing fighting and noncompliant classroom behaviors (Davis, 1979),improving swimming skills (Dowrick & Dove, 1980, learning to step over obstacles (Dowrick & Biggs, 1983), reducing fidgeting, distractibility, vocalizations, and increasing math performance (Woltersdorf, 1992),

spontaneous requesting in children with autism (Wert & Neisworth, 2003), decreasing public speaking anxiety (Rickards-Schlichting, Kehle, & Bray, 2004), increasing social engaged time in children with ASD (Victor, 2011), cooking (McGraw-Hunter, Faw, & Davis, 2006), and teaching preschoolers with Asperger syndrome to follow directions, share with peers, and participate in music class (Crandell & Johnson, 2009).

Williamson et al. (2013) set out to establish some guidelines to determine the prerequisites skills that would make VSM an effective treatment modality. Researchers hypothesized that a child's ability to attend to a video, use verbal communication, imitate, and recognize themselves on the video would all be integral factors. Buggey (2009) had previously suggested that a child's ability to attend and recognize him or herself were imperative factors for a successful VSM treatment. Bellini and Akullian (2007) agree that attention and motivation are essential components of modeling, noting that if the child does not attend to the model, there is little chance they will repeat the exhibited behavior. Bellini and Akullian (2007) added that in addition to model and observer similarity, the competence of the model also increased the probability that the behavior would be imitated. By studying children with autism, researchers added to Buggey's findings by determining that the more a child could engage in all of the above behaviors (attending, verbalizing, imitating, and recognizing), the more effective the VSM treatment would be. Additionally, it was found that a higher quality video led to increased attention, also leading to a more successful outcome.

Single-Subject Research

Similar to this study, much of the research on VSM was conducted using a single subject multiple-baseline approach. This design allows researchers to study participants in-depth across time. The multiple-baseline approach allows for scientific experimentation by adding and removing the treatment condition to determine significant changes in behavior. Case studies were also used, especially in earlier researcher (e.g., Creer &Milklich, 1970). Because of the small number of subjects per study, the number of individuals who have participated in VSM researcher is likely only somewhere in the hundreds. As technology has improved, the rate of VSM research has similarly accelerated, meaning that the number of participants in these types of studies is steadily climbing (Buggey, 2012). With the encouraging results that have been found utilizing VSM research, the increase in the number of studies and participants appears to be a positive research trend.

Single-subject research is a subset of a quantitative quasi-experimental method that allows the researcher to observe the behavior of a very small number of participants at multiple points across time (Creswell, 2013). By observing the participant at these multiple points, a baseline of behavior is established, thus enabling the researcher to track fluctuations in behavior after the intervention is implemented and later withdrawn. Single-subject research can document a practice as evidence –based when all variables and contexts are operationally defined, the study is implemented with fidelity, the resultant changes are found to be contributable to the variables being studied, and studies are replicated enough times to ensure confidence in the findings (Bellini & Akullian,

2007). A multiple baseline design introduces the intervention to different baselines at different points in time (Kazdin, 1982). By introducing the intervention at different points in time across baselines, any resultant changes can be directly attributed to the intervention rather than to extraneous circumstances. When using a multiple baseline design, the researcher does not need to withdraw treatment in order to prove efficacy, thus removing many of the ethical concerns associated with other designs (Kazdin, 1982). This study hopes to contribute to the scientific body of knowledge by increasing the findings related to VSM, therefore strengthening the assertion that VSM is an evidence-based practice.

Theoretical Framework

Albert Bandura is the name most frequently associated with social learning theory, also termed social cognitive theory (Hitchcock et al., 2003). The concept of social learning theory is that much of human learning is advanced through the observation of others. Bandura's 1971 article entitled *Social Learning Theory* detailed many of the nuances of learning. Whereas radical behaviorists placed focus solely on the interaction between environment, response, and consequences, social learning theory attempted to expand that theory by incorporating the higher-level thought processes that are integral to human learning (Bandura, 1971).

In the classic Bandura, Ross, and Ross (1961) Bobo Doll Experiments, researchers divided children into two conditions: nonaggressive and aggressive. During the nonaggressive condition, children were placed in a playroom during which time they observed an experimenter playing nicely with the toys in the room. During the

aggressive condition, children witnessed the experimenter initially playing appropriately with the toys, but quickly becoming aggressive with a 5-foot inflated Bobo doll in the room. After the children exited the room with the experimenter, both groups were then observed in different play areas containing various toys, including a mallet and another Bobo doll. Results showed that the children from the aggressive condition engaged in aggressive behavior more frequently than those in the nonaggressive condition. Similarly, children who had not witnessed any model at all were less aggressive in their play than those in the aggressive condition. Researchers suspected that the children had learned to interact aggressively with the Bobo doll by observing the adult model engaging in aggressive behavior toward the doll. This led to the conclusion that observational learning is highly influential upon behavior. Researchers further stated that modeling could be used to influence and teach behaviors that had previously been performed infrequently or not at all. In other words, observational learning can produce novel behavior, in addition to strengthening behaviors, more quickly than reinforcement and punishment of successive approximations (Bandura et al., 1961).

Prater et al. (2012) later added to Bandura's work by describing how humans receive reinforcement and punishment not only through direct access, but also vicariously. For example, when someone is observed smiling after receiving a compliment, that information may be generalized to a person's own life. If that person find smiles reinforcing, then he or she will be more likely to give others compliments because they know that they are likely to receive a smile because of their behavior. By observing someone else receiving a consequence, a person may vicariously learn to

repeat that behavior to obtain reinforcement or to avoid punishment. Other researchers confirmed the idea that learning has a strong social and vicarious context (Brooks, 2009).

Self-Efficacy

When discussing VSM and Albert Bandura, a key term that arises is *perceived self-efficacy* (Hitchcock et al., 2003). Perceived self-efficacy refers to the beliefs one holds regarding his or her abilities to plan and execute the course of actions required to emit a certain behavior (Bandura, 1997). Bandura postulated that an individual develops perceived self-efficacy by utilizing different strategies, such as vicarious learning and personal accomplishment (Bandura, 1977). Bandura further stated that perceived self-efficacy is a key component of behavioral change (Bandura, 1977). In 1997, he added that perceived self-efficacy could be directly influenced by self-modeling. When a person views a video successfully depicting him or herself modeling a behavior that is slightly beyond his or her ability, this can initiate a perception of self-efficacy. This perception of self-efficacy then increases the likelihood that the person will successfully emit the target behavior (Bellini & Akullian, 2007; Gelbar, et al., 2012). This sense of self-efficacy makes it probable that the person will produce the behavior more frequently in the future (Bandura, 1997).

Filling the Gap

After exploring the available research on ASD, dysgraphia, and video self-modeling, a conclusion was reached that, to date, no research has attempted to examine a VSM treatment approach to treating dysgraphia in children with ASD. In addition to the prior successful use of VSM for improving academic performance, this topic was deemed

worthy of research due to the high prevalence rate of ASD, and the need to prepare these children with the skills necessary to be successful first in school, and subsequently throughout their lives. Success in school is clearly important for academic reasons, but beyond that, it is important for in the development of strong self-esteem and feelings of self-efficacy. With well-developed handwriting skills, life will be significantly easier for these individuals as they move through school, take tests, interact with friends and family, and eventually enter the work force and become contributing members of society. VSM has been shown to be a successful intervention for children with ASD targeting a vast number of skills (Bellini & Akullian, 2007). It seems probable that VSM could be similarly effective for remediating dysgraphia in children with ASD, thereby strengthening communication, improving school performance, and increasing self-esteem.

Methodology

This study analyzed secondary data provided by a local DTC specializing in the care of children with ASD. Therapists at the DTC implemented a VSM procedure for the treatment of dysgraphia during the course of standard operating procedures. A single-subject multiple baseline design was used to determine if the participant's handwriting demonstrated improvement in legibility and proficiency after creating and watching self-modeled videos that had been edited to demonstrate proper handwriting skills. During the intervention, the participants were asked to write his or her name, as well as the word "cat", and the word "apple". These words were chosen by DTC staff from the Woodcock-Johnson III Tests of Achievement (WJ-III ACH Writing Samples subtest.

Legibility was recorded at multiple points before, during, and after treatment using the WJ-III ACH Handwriting Legibility Scale. Proficiency was assessed through a pretest/posttest evaluation based on ratings from the HSPQ and HSPQ-C. Changes between treatment phases was recorded and analyzed using a multiple baseline across participants design. The resultant data was later presented to the student researcher for secondary analyses.

Chapter 3: Research Method

Introduction

The purpose of this research was to determine the efficacy of a video self-modeling (VSM) treatment program for the remediation of dysgraphia. Secondary analyses was conducted on data provided by a DTC specializing in applied behavior analysis (ABA) treatment for children with developmental disabilities. DTC staff implemented a single-subject multiple baseline across participants design to evaluate treatment effects. All procedures were implemented by DTC therapists during the course of standard operating procedures. Data were collected by the DTC staff before, during, and after the intervention, and were later provided to me for secondary analyses.

Participants included three children. All children in the subject pool had been previously diagnosed with ASD by an independent clinician. The score for the primary dependent variable of handwriting legibility was determined through observer ratings based on the Woodcock Johnson Tests of Achievement- 3rd Edition (WJ-III ACH) Handwriting Legibility Scale. Scores for secondary dependent variables related to handwriting proficiency, were derived from pretest/ posttest ratings on the Handwriting Proficiency Screening Questionnaire (HPSQ) and the Handwriting Proficiency Screening Questionnaire for Children (HSPQ-C). The social validity of this research project was measured using the Behavior Intervention Rating Scale (BIRS) and the Children's Intervention Rating Profile (CIRP). This chapter explains the research design, participants, setting, instrumentation, data collection, and analysis procedures that were utilized for this research project.

Procedures

Variables for this study included the independent variable, primary dependent variable, and secondary dependent variable. The independent variable was the video self-modeling treatment. The primary dependent variable was handwriting legibility based on observer ratings. The secondary dependent variable was handwriting proficiency based on staff and participant ratings.

Research Design and Rationale

Secondary data originally collected by DTC staff was analyzed. The DTC utilized a multiple baseline across participants design to evaluate the efficacy of a VSM program for the treatment of dysgraphia in children with ASD. Multiple baseline across participants is a type of single case design that involves multiple observations of a small group of participants who begin treatment at various points in time. Multiple baseline research is widely used within the field of applied behavior analysis for demonstrating behavioral improvements within clinical and educational settings (Gast & Leford, 2014). Horner et al. (2005) wrote that single-subject designs usually involve three to eight participants within a single study.

Population and Sample

The selected sample was chosen by the DTC supervisor. The sample had been drawn from a population of children with ASD who exhibited prior difficulties with handwriting. Consistent with similar VSM research utilizing multiple baseline designs, the participants in this study included three children selected by the DTC supervisor. To qualify to receive the VSM treatment, the DTC supervisor set the following inclusion

criteria for each participant: (a) previous diagnosis of autism spectrum disorder, (b) 7 - 9 years old, (c) ability to attend to a video, (d) verbal communication skills, (e) ability to recognize him or herself, (f) imitation skills, and (g) significant difficulty with handwriting.

Setting

The research site for this study was a DTC specializing in the administration of ABA to children with developmental disabilities in Houston, Texas. The DTC treats approximately 20 children on a daily basis. Children attend the DTC for approximately 3-8 hours per day, depending on the severity of their symptoms and current treatment needs. All intervention procedures occurred during the course of normal treatment hours and were implemented by the DTC staff. All data collection occurred on site by the DTC staff. The DTC is a configuration of adjoining child-friendly classrooms contained within an office building in central Houston. For this intervention, the participants viewed the videos and practiced their handwriting skills within a classroom containing a table, two chairs, and various toys shelved along the wall.

Instrumentation and Materials

Staff at the research site used a Samsung Galaxy s6 smart phone to record the VSM lessons. The Samsung Galaxy s6's high-definition video mode captures 1080 horizontal lines of resolution at 60 frames per second. Windows Movie Maker editing software was used to edit and finalize all of the VSM lessons.

Woodcock Johnson Tests of Achievement- 3rd Edition.

The WJ-III ACH is a standardized, nationally norm-referenced achievement test that is suitable for individuals age 2 years through 90+. Participants completed items 1, 2, and 3 from the Writing Samples subtest, which is Test 11 of the WJ-III ACH standard battery. Item 1 asked the participant to write his or her first name. Item 2 asked the participant to write the word "cat". Item 3 asked the participant to write the word "apple" (McGrew & Woodcock, 2001). Two observers scored each participant's handwriting on these items based on the Handwriting Legibility Scale, which can be found in the WJ-III ACH immediately following the Writing Samples subtest. Scores were calculated utilizing a numerical value between 0 and 100 to reflect the participant's handwriting abilities.

A score of "0" indicates writing that is completely illegible, while a score of "100" indicates perfect, "artistic" adult-level handwriting (McGrew & Woodcock, 2001). The numerical value on the legibility scale was calculated based upon factors such as slant, spacing, size, horizontal alignment, letter formation, and line quality. Raw numerical scores from the Handwriting Legibility Scale were calculated by two raters for each participant on each item. The scores between the two raters were averaged to form a final score. Initially, raw scores were probed daily to construct a baseline. After the baseline was established, raw scores were collected daily, and used to determine differences among baseline, treatment, and maintenance phases.

The WJ-III ACH reports a high level of interrater reliability for the Writing Samples subtest. The median correlation between two raters for second-grade

respondents was .93. A second study showed the median correlation at .99 for third graders. When the interrater reliability ratings were determined for the Handwriting Legibility Scale, the median score was reported at .*75* for third-grade respondents. Writing Samples has a median reliability of .84 in the 5 to 19 range and .91 in the adult range (McGrew & Woodcock, 2001). The goal of the WJ-III ACH was to ensure high content validity. Content validity was ensured by structuring the test content to cover the core curricular areas specified in federal legislation (McGrew & Woodcock, 2001). No specific validity scores were reported for the WJ-III ACH. Permission to use this scale is provided in the WJ-III ACH Examiner's Manual. A copy of the Handwriting Legibility Scale will be included in Appendix A. A copy of the sample scoring provided in the WJ-III ACH Examiner's Manual for the Handwriting Legibility Scale is included in Appendix B.

Handwriting Proficiency Screening Questionnaire (HPSQ) & Handwriting Proficiency Screening Questionnaire for Children (HPSQ-C).

The HSPQ and HSPQ-C are lexical measurements of handwriting created by Rosenblum and Gafni-Lachter (2015). The HSPQ and HSPQ-C was used before and after the intervention as a pretest/posttest measure. Both the HSPQ and the HSPQ-C assess the level of readability of the target child's handwriting, while simultaneously assessing related issues, such as hand pain associated with writing, frequency of erasing, and overall satisfaction with the writing process. The HSPQ is a 10-item rating scale that is filled out by an adult observer. The HSPQ-C is a 10-item self-report checklist filled out by the participant. Both forms ask the respondent to rate all 10 items on a scale of 0

(never) to 4 (always). Scores closer to 40 indicate serious deficits in handwriting, while lower scores indicate a greater proficiency with handwriting. The HSPQ will be completed by DTC therapists, and the HSPQ-C will be completed by the participants with the help of their therapists (e.g. DTC therapists will read the questions aloud to each participant and will then transcribe their verbal responses). Though some participants may be able to read and answer the questions independently, this method of having the questions read aloud and recording the participant's answers was used for all participants to maintain consistency.

The HSPQ-C is appropriate for use with children with moderate verbal communication skills, who can understand these types of questions and respond accurately. Reading level is negotiable because it is permissible to read the items aloud to the participant. An analysis of reliability indicated that the HSPQ-C demonstrated good internal consistency (α=.77). Concurrent validity was also established between the HSPQ and the HSPQ-C (r=.51, $p < .001$). Construct validity was confirmed using confirmatory factor analysis. Analysis by the authors showed that the HSPQ and the HSPQ-C distinguished between children with and without handwriting deficiencies (Rosenblum, 2008; Rosenblum & Gafni-Lachter, 2015). Because this measure is so new and was unpublished at the time of this proposal, independent research has not yet confirmed the author's findings. Permission to use the HSPQ and HSPQ-C was granted by the author. A copy of the HSPQ will be included in Appendix C. A copy of the HSPQ-C will be included in Appendix D. A copy of the permission letter to use these instruments can be found in Appendix E.

Social Validity Measures.

The social validity of this study was measured using modified versions of the Behavior Intervention Rating Scale and the Children's Intervention Rating Profile. The BIRS that was used for this study will be a modified version of the Intervention Rating Profile-15 (IRP-15) featuring 24 questions that will be rated on a Likert scale ranging between 1 (strongly disagree) and 6 (strongly agree). This instrument was used to measure the rater's perception of treatment acceptability. The BIRS has been successfully utilized in studies to assess the social validity of treatments (Erchul et al., 2009; Miller, DuPaul, & Lutz, 2002).

The BIRS total score ranges from a 24-144. Internal consistency is reported at .97 (Carter, 2007). Higher mean item scores (i.e., 5 or 6) are associated with greater acceptability of the intervention, while lower mean scores (i.e., 1 or 2) are associated with lower acceptability (Elliot & Treuting, 1991). Adaptations were made to this scale to emphasize the acceptability of this intervention within the DTC setting. The modified BIRS was completed by the behavioral therapists administering the VSM treatment. Completion of the form is estimated to last approximately 10 minutes. Results of the BIRS assessment were scored and analyzed by DTC staff. The BIRS is not copyrighted, and is available for use without the author's permission. A sample of the BIRS that was used in this study can be found in Appendix F.

The CIRP was used to determine the participants' perceived acceptability of the VSM treatment. The CIRP has been used to measure the acceptability of various interventions. Results suggest acceptable levels of reliability and validity (Cowan &

Sheridan, 2003). The CIRP consists of seven self-report items related to the perceived fairness and expected effectiveness of a treatment (Carter, 2007). The CIRP has demonstrated an internal consistency of .75 to .89 (Carter, 2007). Items on this instrument are rated on a Likert scale ranging in selection from 1 (agree very much) to 6 (disagree very much). In contrast to the BIRS, lower scores on the CIRP signify higher acceptability (Cowan & Sheridan). For comparison purposes, the CIRP responses were reversed-coded so that higher mean items will signify greater acceptability. Additional adaptations to the scale included the re-wording of several items in order to reflect the clinical treatment basis of the intervention. Questions on the CIRP were written on a fifth-grade reading level. Similar to the HSPQ-C, items were read aloud to the participants and their answers recorded by DTC therapists. The CIRP is not copyrighted, and is available for use without the author's permission. A sample of the modified CIRP that was used in this study is provided in Appendix G.

Data Collection

Establishing the Baseline

Similar to previous VSM research, the DTC utilized a multiple baseline across participants design; therefore, baseline data was collected for each participant for varying increments of time, allowing for different start points for the subsequent treatment phase. Because the treatment phase was started at different times, conclusions could be drawn that changes were due to the treatment rather than to a chance factor (Christ, 2007). All data were collected by DTC staff. No data were provided to the student researcher by the

DTC prior to gaining approval from Walden University's Institutional Review Board (IRB).

Following IRB approval, the DTC allowed the student researcher access to information on the data collection procedures. Baseline data was collected until a stable baseline had been established. One session was conducted each day during all phases of the study. Establishing the baseline took 5 days for Participant 1, 8 days for Participant 2, and 11 days for Participant 3. Data for all phases of this study were collected during the course of the DTC's standard operating procedures. Treatment sessions occurred in the morning to promote attention and ensure consistency among participants.

During baseline, the therapist issued each SD to the client to write the target word (i.e., "Write your name," "Write the word cat," "and Write the word apple"). The client was given one piece of lined handwriting paper and a pencil presented in front of them prior to the SD being issued. The response made by the participant (i.e. all three words produced within a single session written on one piece of paper) was rated by two therapists using a numerical value between 1 and 100 based on the WJ-III ACH Handwriting Legibility Scale, as detailed above. The same two therapists were used across participants to ensure consistent scoring. The therapists used the sample scoring presented in Appendix B to jointly determine one raw score for each day, which was then documented appropriately. Once the baseline was established, the treatment phase began.

Video Creation

After the participants were selected by the DTC supervisor, each participant took part in creating a video. The DTC directed the making of the videos. The setting of the

video was the same classroom where the intervention took place. Participants sat in a chair at the table located within the classroom. The video recorder on the cellular phone (described within the instrumentation section above) recorded the participant sitting at the table from behind the child's head. The camera view showed the back of each child's head enough that the participants were able to recognize themselves without showing the participants' faces. The recording was taken from just slightly above the participant's head so that the video showed the participants' hands and the piece of lined handwriting paper placed directly in front of him or her on the table. A voice off camera issued SDs. The first SD was "Write your name." The video showed the participant picking up a sharpened No.2 pencil and writing his or her name on the top line. The video was edited to make the writing process look smooth and correct. After the participant's name had been written, the voice off camera issued the second SD: "Write the word cat." Again, the video was edited to display an appropriate depiction of the participant writing the word "cat" on the second line. Then the third SD was given: "Write the word "apple." The video was edited to show the participant writing the word "apple" on the third line. After this third word was spoken, the voice off camera issued a verbal reinforcer of "Good job!" and the participant was instructed to put down his or her pencil. The participant's face was not directly shown on camera. To ensure that the participant recognized himself or herself, following the first viewing of the self-modeled video, the participant was asked "Who is that?" All participants responded correctly to this question, thus no further prompting was necessary.

Each participant made a video that showed him or her smoothly and correctly writing the three target words. The final edited videos ran between 1-2 minutes in length. A sample of the handwriting paper used in the video is provided in Appendix H.

Treatment Phase

The treatment phase for this study included the period of time when the participants were exposed to the video model lesson. Immediately following completion of the baseline, data collection for the VSM treatment began. Participant 1's sessions began after 5 days of baseline instruction and continued for 5 days. Participant 2's sessions began after 8 days of baseline instruction and continued for 5 days. Participant 3's sessions began after 11days of baseline instruction and continued for 5 days.

During the treatment phase, the DTC therapist reportedly played the self-modeled video at the beginning of each session. The videos ran between 1 and 2 minutes. Therapists only provided prompts to redirect the client's attention as necessary. Proper attention skills were verbally reinforced for each participant (e.g. "Nice looking at the video"). After viewing the video, the therapist gave the participant the same type of pencil and one piece of writing paper as depicted in the video. The therapist issued the same SDs as depicted in the video (i.e. "Write your name," "write cat," "write apple"). Modeling previous VSM research, the treatment phase continued in this way for 5 consecutive days. Participant's responses were rated by two therapists using a numerical value between 1 and 100 based on the WJ-III ACH legibility scale, as detailed above. The raters conferred to determine a final score, which was then documented appropriately.

Maintenance Phase

Four weeks after the conclusion of the treatment phrase, the DTC staff resumed data collection. The participants were again issued the same SDs to write each of the targets words. During the maintenance sessions, participants did not view the self-modeled video prior to performing the target behavior. Each participant completed 5 days of maintenance sessions post-treatment, which began four weeks after his or her last intervention session was completed. The same two therapists were again jointly responsible for determining one numerical score for each handwriting sample based on the WJ-III ACH Handwriting Legibility Scale Sample Scoring.

Research Questions and Hypotheses

Treatment Phase Research Questions and Hypotheses

Research Question: Are significant differences evident in the legibility of handwriting when utilizing a VSM treatment approach**?**

The treatment phase data is presented in Chapter 4 and used to determine if hypotheses 1, 2, and 3 were accepted.

H_a1: The participant will demonstrate an increase of 10 points or more when writing his or her name, as measured by daily target probes.

H_01: The participant will demonstrate an increase of less than 10 points when writing his or her name, as measured by daily target probes.

H_a2: The participant will demonstrate an increase of 10 points or more when writing the word “cat”, as measured by daily target probes.

$H_0$2: The participant will demonstrate an increase of less than 10 points when writing the word “cat”, as measured by daily target probes.

H_a3:The participant will demonstrate an increase of 10 points or more when writing the word “apple”, as measured by daily target probes.

$H_0$3: The participant will demonstrate an increase of less than 10 points when writing the word “apple”, as measured by daily target probes.

Maintenance Phase Research Questions and Hypotheses

Maintenance data was collected for 5 days four weeks after the completion of the participant’s last treatment session. During the maintenance phase, therapists did not show participants the self-modeled videos, but still issued the same three SDs to each participant. Raw score data from the WJ-III ACH Handwriting Legibility Scale was collected from two observers and averaged to calculate a final score.

Research Question: Are significant differences evident in the legibility of handwriting four weeks after the conclusion of a VSM treatment program**?**

The results of the maintenance phase data are presented in Chapter 4 and used to accept or reject hypotheses 4, 5, and 6.

H_a4: The participant will maintain an increase of at least 5 points when writing his or her name, as measured by daily target probes.

$H_0$4: The participant will not maintain an increase of at least 5 points when writing his or her name, as measured by daily target probes.

H_a5: The participant will maintain an increase of at least 5 points when writing the word “cat”, as measured by daily target probes.

$H_0$5: The participant will not maintain an increase of at least 5 points when writing the word “cat”, as measured by daily target probes.

H_a6: The participant will maintain an increase of at least 5 points when writing the word “apple”, as measured by daily target probes.

$H_0$6: The participant will not maintain an increase of at least 5 points when writing the word “apple”, as measured by daily target probes.

Pretest/ Posttest Evaluation

A pre-test/ post-test evaluation was given by DTC staff to the DTC therapists who had participated in the intervention and participants before beginning the baseline treatment and following the end of the maintenance phase to determine handwriting proficiency. This evaluation was based on scores obtained from the HSPQ and the HSPQ-C. The HSPQ will be given to the therapists before baseline began and after maintenance ended. Similarly, the HSPQ-C was given to each participant before baseline began and after maintenance ended. Raw score data from the HSPQ was collected from two observers and averaged to calculate a final score.

Research Question: Are significant differences evident in the proficiency of handwriting following a VSM treatment approach**?**

The results of the pretest/ posttest data will be presented in Chapter 4 and will be used to accept or reject hypotheses 7 and 8.

H_a7: The participant’s self-report score will improve by 6 points or more from pretest to posttest on the HSPQ-C.

$H_0$7: The participant's self-report score will not improve by at least 6 points from pretest to posttest on the HSPQ-C.

H_a8: The participant's score will improve by 6 points or more from pretest to posttest on the HSPQ.

$H_0$8: The participant's score will not improve by at least 6 points from pretest to posttest on the HSPQ.

Social Validity

The social validity of this study was measured with a modified version of the BIRS and the CIRP. Following the maintenance phase, therapists and participants were asked by DTC staff to fill out their respective social validity rating scales. Results of these measurements are presented in Chapter 4 and provide information about the acceptability of the VSM as a treatment for handwriting difficulties in children with ASD.

Therapists. Do therapists believe that video self-modeling is a socially acceptable treatment approach for dysgraphia in children with ASD within a day treatment center setting?

The results obtained from the BIRS were used to accept or reject hypothesis 9.

H_a9: The average rating of the therapist's modified BIRS will be a 4 or above indicating that he or she believes the VSM intervention is an acceptable treatment within a day treatment center setting for handwriting difficulties in children with ASD.

$H_0$9: The average rating of the therapist's modified BIRS will not be a 4 or above indicating that he or she believes the VSM intervention is not an acceptable treatment within a day treatment center setting for handwriting difficulties in children with ASD.

Participants. Do participants believe that video self-modeling is a socially acceptable treatment approach for dysgraphia within a day treatment center setting?

The results obtained from the CIRP were used to accept or reject hypothesis 10.

H_a10: The average rating of the participants' modified CIRP will be 4 or above indicating that he or she believes the VSM intervention is an acceptable treatment to receive within a day treatment center setting.

$H_0$10:The average rating of the participants' modified CIRP will not be 4 or above indicating that he or she believes the VSM intervention is not an acceptable treatment to receive within a day treatment center setting.

Data Analysis

Secondary data provided by the DTC supervisor to the student researcher was analyzed following the conclusion of the intervention. In addition to legibility and proficiency data, social validity, treatment fidelity, and demographic information including age, gender, and ethnicity was included for each participant. These data are used to inform future research and potentially improve internal validity. Horner et al. (2005) noted that single-subjects design can achieve high internal consistency by providing detailed procedural information that can be easily replicated by additional researchers. Including a variety of participants increases the external validity in this type of research.

The DTC supervisor indicated that the goal of the baseline phase had been to achieve a stable baseline that fell within 10-20% of the mean. Data points were collected until this goal was achieved, at which point the treatment phase began. Graphs are provided allowing for a visual representation of the impact of the intervention both within and across treatment phases. The effect sizes of these changes were measured using a confidence interval of 95%. Cohen's *d*, which was used to evaluate effect size, was calculated by subtracting two means and then dividing them by the sum of their standard deviations. Cohen's *d* is identified between the participant's baseline and treatment phases, as well as between the baseline and maintenance phase. Larger effect sizes demonstrate higher levels of statistically significant results (Olejnik & Algina, 2000).

Research Limitations

One limitation of this research was that the participants were all fairly similar in terms of demographics. Each participant was between 7 and 9 years of age. Each participant attended the same day treatment center. Because the cost of daily treatment at the DTC is high, the SES for each participant fell above the average median income. Participants also had the same diagnosis, and similar skill levels were necessary to qualify for participation.

A second limitation of this research was that the research had a highly specified focus. The focus of the research is on writing three particular words. Determining the efficacy of a VSM treatment program for writing three specific words may not fully account for generalization of handwriting skills to other words. Further research evaluating the utility of VSM for dysgraphia could prove valuable.

This study utilized the *WJ-III ACH Handwriting Legibility Scale*, which did not report numerical validity data. Reliability data looks strong, but numerical validity data was unavailable. Similarly, the *HSPQ* and *HSPQ-C* are relatively new forms that had not yet been published prior to the writing of this dissertation. According to Rosenblum and Gafni-Lachter (2015), the *HSPQ* and *HSPQ-C* show high internal consistency, concurrent validity, and construct validity; however, this information has not yet been confirmed by independent research.

The potential for the influence of extrinsic factors on results provided another potential limitation. Though DTC staff were reportedly instructed to not work on handwriting outside of the context of the VSM study, it was possible that these skills were practiced at home with family members. Additional reinforcement could also have been provided by parents or other family members on writing tasks, thus potentially affecting the results of this study. If future research is conducted in this area, it could be helpful to control for these types of extrinsic factors.

Protection for Participants and Privacy

In order to maintain the highest level of rights and protection, this study will obtain permission from the Institutional Review Board of Walden University. All data is archival and no participant was or can be identified. All data is coded and stored securely. All hard copies provided to the data entry specialist were destroyed. All test databases were expunged at the end of each corresponding school year. Original protocols, (paper records) are secured by the DTC. Consistent with legal and regulatory requirements, as well as ethical standards (e.g., Ethics Code, Standard 6.02; HIPAA

Privacy and Security Rules), procedures are in place to limit access of records to this researcher.

Data will be stored indefinitely in a password protected computer program. In order to safeguard the archived data and address concerns of confidentiality and protection from harm, the above procedures will be closely followed.

Data Collection and Analysis

According to the agreement, all DTC protocol forms were provided by behavioral analyst therapists employed by the DTC. In addition, the DTC owns, protects, stores, and maintains all completed protocols and all written reports. The DTC has provided permission to utilize the data for this study. All student, parent, and therapist identification was removed. Participants received a unique numerical identification for data coding.

All data were collected during the course of standard operating procedures, meaning that the participants did not endure any additional expenditure of treatment time. All procedures were conducted at the DTC, to ensure that participants and their guardians did not incur any additional travel time or expense.

The staff at the research site was also provided with the contact information of all the individuals on the research committee in order to facilitate communication between the research site and research committee. No compensation was offered to the participants by the DTC for participation within this research. As requested, a copy of the final dissertation will be provided to the DTC, so that information regarding the final

outcome of the intervention could be potentially incorporated into future intervention plans.

Summary

Chapter 3 of this proposal delineates the specific procedures of this research. This study analyzed de-identified secondary data provided by a DTC specializing in ABA treatment of children with developmental disabilities. All data was collected by staff at the DTC. A single subject multiple baseline design was utilized by DTC staff with three participants. The DTC supervisor selected appropriate participants based on the inclusion criteria described above. Treatment occurred within the course of standard operating procedures and was fully implemented by DTC staff members. A baseline of behavior was established, followed by the implementation of a treatment phase that included watching a self-modeled video of the participant completing the target behavior before attempting the target behavior in-vivo. A maintenance phase occurred four weeks following the conclusion of the treatment phase. A pretest/ posttest evaluation was given to both participants and raters to measure potential improvement following the study. Cohen's *d* was used to establish effect sizes, and graphs will provide a visual representation of changes that occurred throughout baseline, treatment, and maintenance phases. The social validity of this research was established using a modified version of the *BIRS* and the *CIRP*. Participants and the parents of participants provided assent and consent, respectively, and precautions were taken to protect all parties involved. Data were provided to the student researcher by DTC staff following the conclusion of the VSM treatment program for analyses of secondary data. Findings from the research will

be provided to the DTC, so that future clients may benefit from any positive treatment effects that may be established. The results of this research are discussed in Chapter 4.

Chapter 4: Results

Introduction

Children with autism spectrum disorder (ASD) often present with handwriting difficulties that can lead to problems with communication, school performance, and self-esteem. Video Self-Modeling (VSM) is a cognitive-behavioral treatment modality that has shown to be successful as a treatment for children with ASD in cultivating social interactions, increasing the frequency of verbalizations, and improving daily living skills.

The purpose of this research was to determine if VSM is an effective treatment for dysgraphia in children with ASD. The goal was to discover if significant differences were evident in the legibility and proficiency of handwriting after utilizing a VSM treatment approach. **S**econdary data collected by a Day Treatment Center (DTC) specializing in the treatment of children with developmental disabilities was analyzed after the conclusion of the intervention. DTC reports stated that baseline data were collected, followed by the implementation of the VSM treatment. Data measuring legibility were collected throughout treatment, as well as during a maintenance phase 1 month later. A pretest/posttest measure was also collected to determine improvements in proficiency. It was hypothesized that significant gains would be found immediately following the intervention and that these gains would still be evident 1 month post treatment.

This chapter will summarize the findings of these data. Methods of data collection will be detailed, including the time frame for data collection and response rates. Descriptive and demographic characteristics of the sample will be examined.

Treatment fidelity will be discussed, illuminating any reported changes that occurred during the original data collection procedures. This will be followed by a summary of the results, including effect sizes and their relationship with the hypotheses. Tables and graphs will provide pictorial representation of the findings when appropriate.

Description of Sample

The DTC supervisor at the research site selected three participants from a population of children with ASD who had exhibited prior difficulties with handwriting. The three participants chosen had to: (a) have a previous diagnosis of autism spectrum disorder, (b) be between the ages of 7 and 9 years old, (c) be able to attend to a video for a minimum of 2 minutes, (d) exhibit verbal communication skills, (e) recognize him or herself in a video, (f) exhibit imitation skills, and (g) exhibit significant difficulty with handwriting. The timeframe of 2 minutes was selected based on research from Buggey (2007), who stated that a video intervention is generally most successful when individuals can attend to the video for at least 2 minutes.

The selected sample included two Caucasian boys and one African American girl between the ages of 7 and 8. The participants' specific demographics are provided in Table 1. All three participants had received prior diagnoses of ASD and were enrolled in full-time treatment at the DTC. The DTC supervisor assessed the participant's attention span, verbal communication skills, imitation skills, and handwriting abilities prior to beginning the VSM treatment. During the data collection time frame participants continued to receive their usual treatment, but did not receive any additional treatment related to handwriting difficulties. DTC staff was reportedly instructed to avoid any tasks

associated with handwriting skills in order to preserve the integrity of the results as much as possible. More detailed information for each participant is described below within the individual participant's legibility results section.

Table 1

Participant Demographics

Participant	Gender	Age	Ethnicity
Participant 1	Female	7 yr. 3 mo.	African-American
Participant 2	Male	7 yr. 1 mo.	Caucasian
Participant 3	Male	8 yr. 6 mo.	Caucasian

Analysis of the Data

Secondary data collected by DTC staff was used for analysis. A quantitative, single-subject, multiple-baseline design was reportedly utilized by the DTC across three participants. The design included the scattering of baseline data collection points as suggested by Sharpley (2007). This was achieved during data collection by collecting Participant 1's baseline data for five sessions, Participant 2's baseline data for eight sessions, and Participant 3's baseline data for 11 sessions. The pattern of all the participant's baseline performances was viewed to be relatively stable (Figure 1). Visual and quantitative analysis of the participant's data was used to determine the changes in the mean level of performance, the trend or slope, latency of response, percentage of nonoverlapping data points (PND), and effect size. The participant's legibility data is represented in a multiple baseline graph (Figure 1). A line graph was used to depict the raw scores of each probe, which is displayed with black solid lines. On each graph the *y*-

axis represents the participant's raw score on each probe and the *x*-axis indicates the session number. The current phase (Baseline, Intervention, and Maintenance) is also displayed on the *x*-axis of each graph.

Variables

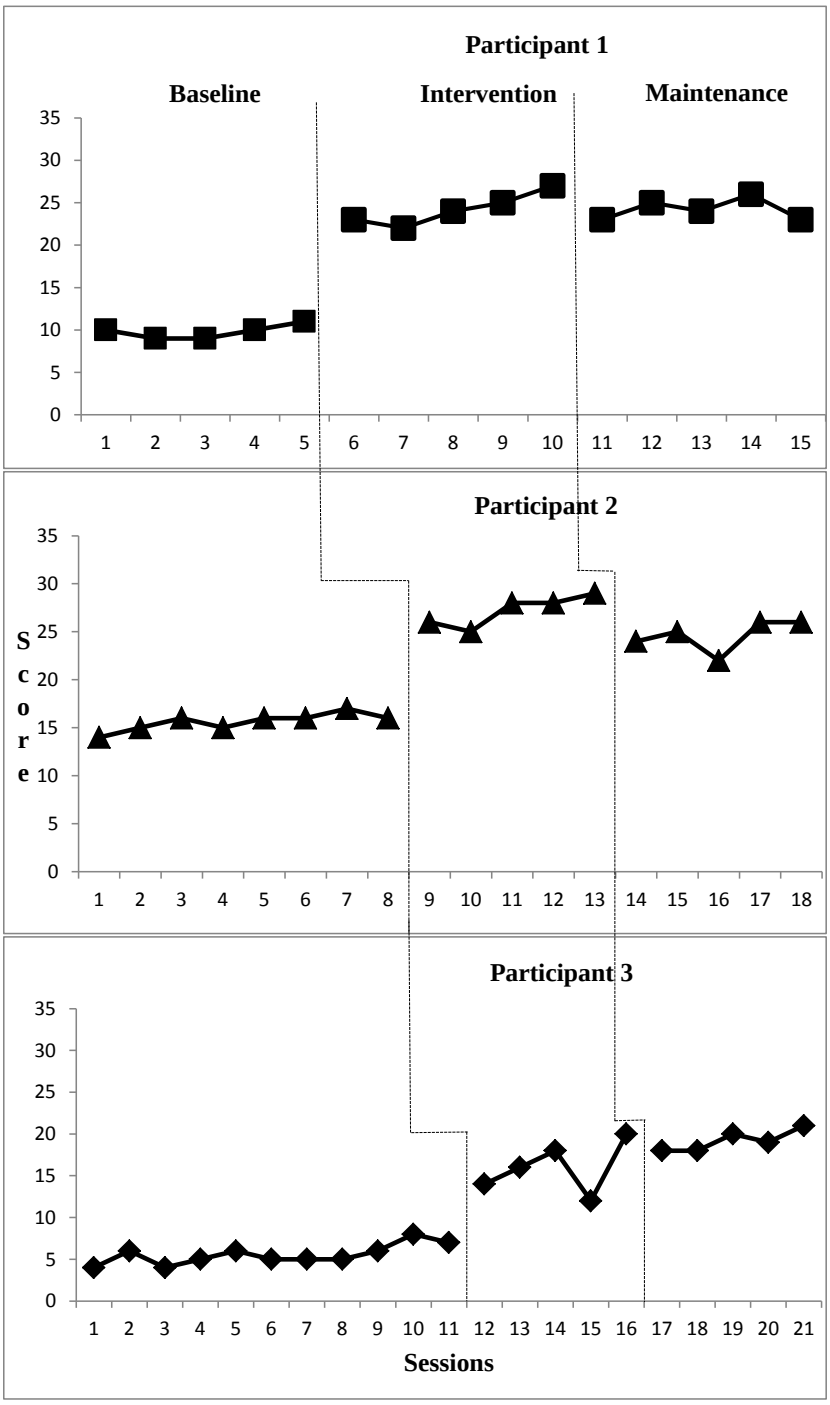
The aim of this research was to identify differences in the legibility and proficiency of handwriting skills following VSM treatment in a sample of children with ASD. The independent variable was the VSM treatment. The primary dependent variable was handwriting legibility based on observer ratings. The secondary dependent variables were related to handwriting proficiency based on staff and participant ratings. The participant's raw scores were used to identify their progress on each line graph.

Legibility

The first research question examined whether the VSM intervention had an effect on the participant's handwriting legibility. In order to reject the null hypotheses for the treatment phase research question, the participant must have demonstrated an increase of at least 10 points when writing his or her name, the word "cat," and the word "apple," as measured by daily target probes. The maintenance phase research question examined whether the participant maintained the intervention level of performance 4 weeks post treatment. In order to reject the null hypothesis of the maintenance phase research question, the participant must have maintained at least a 5 point increase of performance over his or her baseline performance. The changes in the participant's performance, trends, the percentage of non-overlapping data points (PND), and the effect size (ES) are discussed as part of the visual analysis and the quantitative analyses. Statistical analysis

of the PND was identified by calculating the percent of intervention points that did not overlap with the highest baseline data point, in a method suggested by Bellini, Akullian, and Hopf (2007). According to Bellini et al., PND scores that are equal to or above 90% are considered to be very effective, scores that are between 70 and 90% are considered effective, scores between 50 and 70% are considered questionable, and anything below 50% is considered to be ineffective.

Effect sizes (ESs) were also used to provide further statistical support for the data. The ES index that was used to investigate the impact of the VSM treatment was Cohen's *d*. Cohen's *d* is widely used index of ES (Grice & Barrett, 2014). All effect sizes are reported using *d* and were derived by dividing the difference of the observation means (intervention-baseline and maintenance-baseline) by the baseline standard deviation (Jenson, Clark, Kircher, & Kristjansson, 2007). According to Matyas and Greenwood (1990), *d*=.2 is typically classified as a small effect size, *d*=.5 is a medium effect size, and *d*=.8 or higher is identified as a large effect size.


Participant 1
Baseline
Intervention
Maintenance
Participant 2
Score
Participant 3
Sessions

Participant 1. Participant 1 was an African American girl, age 7 years, 3 months at the start of data collection. She was diagnosed at age 4 years old with ASD Level 2, indicating that her severity level would require substantial support. Participant 1 exhibited marked deficits in verbal and nonverbal social communication skills. She had been enrolled in the DTC for approximately 18 months at the start of treatment. Her total language skills were reported at an approximately 5 year-old level and the goal was for her to enter an integrated 2nd grade classroom within the next year.

Data for Participant 1 can be found in Figure 1 and in Tables 2 and 3. Participant 1 had five baseline sessions, five treatment sessions, and five maintenance sessions. Her results are described below.

Participant 1's legibility scores are shown in Figure 1. Participant 1's mean baseline level of performance was calculated to be 9.8. The baseline was found to be relatively stable over the five recorded sessions, falling between 9 and 11 points. During treatment, Participant 1's mean legibility level was calculated to be 24.2 with a standard deviation of 1.24. These scores were also generally stable, falling within a range of 23 to 26 points. A trend of increasing legibility was observed when comparing Participant 1's baseline data to her intervention data, moving from a low to moderate level. Participant 1 began to respond to the intervention immediately following Session 1 of the intervention. As stated earlier, Research Question 1 was used to examine whether the participant would increase her legibility raw score by at least by 10 points over baseline. Participant 1 increased her mean legibility raw scores between baseline and intervention phases by 14.4 points, indicating that Null Hypotheses 1, 2, and 3 should be rejected.

Additionally, a quantitative analysis of scores demonstrated that Participant 1's PND from baseline to intervention score was calculated to be 100%. According to Bellini et al. (2007) a PND of at least 80% is considered an effective intervention. Therefore, this VSM intervention is considered to be a very effective treatment for Participant 1. Participant 1's baseline to intervention legibility was calculated to have an ES of 11.6. According to Cohen (1977) an ES above 0.8 is considered to have a large effect.

The maintenance phase research question investigated whether the participant could maintain an increase of at least five points once the VSM treatment was removed for 4 weeks. Participant 1's post-treatment legibility is shown in Figure 1. As stated above, Participant 1's mean baseline level of performance was calculated to be 9.8. Her mean maintenance level of performance (similar to her mean intervention performance level) was also calculated at 24.2, again demonstrating an increase of 14.4 points over baseline. This meets the criteria for rejecting Null Hypotheses 4, 5, and 6.

Analysis of Participant 1's baseline to maintenance PND score was calculated to be 100%, indicating that VSM is an effective treatment for maintaining an increase in handwriting legibility. Equal to baseline to intervention data, Participant 1's baseline to maintenance legibility showed an ES of 11.6, indicating a large effect.

Participant 2. Participant 2 was a Caucasian boy, age 7 years, 1 month. He was diagnosed at age 3 with ASD Level 1, indicating that his severity level would require support. Without support, Participant 2 exhibited noticeable impairments in verbal and nonverbal social communication skills. He had been enrolled in the DTC for

approximately 14 months at the start of treatment. His total language skills were reported at an approximately 6-year old level, and the goal was for him to enter an integrated 2nd grade classroom within the next year.

Participant 2's data is presented in the same order as Participant 1's addressing the first two research questions. The only difference between the presentation of Participant 1's and Participant 2's data is the number of baseline sessions, which was extended to 8 to allow for a different intervention start time.

Participant 2's legibility scores are shown in Figure 1. Participant 2's mean baseline level of performance was calculated to be 15.62. The baseline was found to be relatively stable over the 8 recorded sessions falling within a range of 14 to 17 points. During treatment, Participant 2's average legibility score was calculated to be 27.2 with a standard deviation of .72, with scores falling within a range of 25 to 29 points. Participant 2 increased his mean score by 11.58 points from baseline to intervention, indicating that the criterion was met to reject Null Hypotheses 1, 2, and 3. A trend of increasing legibility was observed when comparing Participant 2's baseline data to his intervention data, moving from a low to moderate level. Participant 2 also began to respond to the intervention immediately following Session 1 of the intervention. Participant 2's PND results can be found in Table 4. A PND of at least 80% is considered an effective intervention. Participant 2's PND from baseline to maintenance score was calculated at 100%, indicating a very effective level of treatment. Participant 2's baseline to intervention legibility had an effect size of 12.47, also indicating a very

large effect size (Jenson et al., 2007). Analysis of Participant 2's ES can be found in Table 5.

The Maintenance Phase Research Question investigated whether the participant could maintain at least a 5 point increase in raw score after the VSM treatment had been removed for four weeks. Participant 2's maintenance data is shown in Figure 2. Participant 2's average baseline level of performance was calculated to be 15.62. His average maintenance level of performance was calculated at 24.6. Participant 2 maintained an increase of 8.98 points, higher than the minimum 5 points necessary for rejecting Null Hypotheses 4, 5, and 6. Analysis of Participant 2's maintenance data indicated that he maintained his level of handwriting legibility, resulting in a PND score of 100%. This classified the treatment as highly effective with an ES of 12.47, which is considered to be a large effect size.

Participant 3. Participant 3 was an 8 year, 1 month old Caucasian male. He was diagnosed at age 5 with ASD Level 2, indicating that his severity level would require substantial support. Participant 3 exhibited marked deficits in verbal and nonverbal social communication skills. He had been enrolled in the DTC for approximately 23 months at the start of treatment. His total language skills were reported at an approximately 6 year-old level, and the goal was for him to enter an integrated 2nd grade classroom within the next year.

Participant 3's legibility scores are shown in Figure 1. Participant 3's data presentation is the same as the previous participants with the exception of the number of baseline sessions, which consisted of 11 sessions in this case. Participant 3's average

baseline level of performance was calculated to be 5.54 with a standard deviation of 1.04. The baseline was found to be relatively stable over the 11 sessions, with a range of 4 to 8 points. During the intervention, Participant 3's average level of legibility was calculated to be 16. This indicates an increase of 10.46 points from baseline to intervention phase, surpassing the minimum criterion of 10 points necessary for rejecting Null Hypotheses 1, 2, and 3 in the Treatment Phase Research Question. A trend of increasing legibility was observed when comparing Participant 3's baseline data to his intervention data, changing from a low to moderate level of response. Participant 3 also began to respond to the intervention immediately following Session 1 of the intervention. Participant 3's PND from baseline to intervention score was calculated at 100%, thus showing this to be an effective treatment. Participant 3's baseline to intervention legibility had an effect size of 10.06, indicating a large effect size.

The Maintenance Phase Research Question investigated whether the participant could maintain at least a 5 point raw score increase once the VSM treatment had been removed for four weeks. Participant 3's post-treatment legibility scores are shown in Figure 3. Participant 3's average baseline level of performance was calculated to be 5.54, while his maintenance level of performance was calculated at 19.2. These scores demonstrate not only a maintenance of skills after the 30 day period without treatment, but actually a strengthening of skills, by 13.66 points between baseline and maintenance phase. This surpasses the criterion of 5 points necessary to reject Null Hypotheses 4, 5, and 6.

Analysis of Participant 3's baseline to maintenance data showed that his PND score was calculated at 100%, again indicating a highly effective level of treatment. Participant 3's baseline to maintenance achievement had an ES of 13.87, which further providing evidence of the effectiveness of VSM is a treatment for improving the handwriting legibility of this participant.

Proficiency

Changes in handwriting proficiency were measured with pretest/ posttest data gathered from the *HSPQ* and the *HSPQ-C*. These data was used to answer the Pretest/ Posttest Research Questions 7 and 8. Therapists completed the 10-item *HSPQ* before baseline data was collected and at the conclusion of the maintenance phase. Therapists read the 10-item *HSPQ-C* questionnaire aloud to each participant and recorded their responses. A score of 40 is the highest score a respondent can earn, indicating the most significant level of difficulty with handwriting proficiency. The participants responded to the pretest questionnaire before beginning baseline data collection and at the conclusion of the maintenance phase. A visual representation of changes between pre- and post-test scores can be found in Figures 2, 3, and 4.

Participant 1. Participant 1's pretest self-report score on the HSPQ-C was 32 out of 40. Her posttest score had decreased by 2 points to 30. Participant 1 endorsed a decrease in the difficulty others have reading her handwriting. She also reported a decrease in the frequency of erasing during a writing task. Therapist's ratings on the HSPQ indicated a decrease of 5 points from a pretest score of 35 to a posttest score of 30. The therapist reported that Participant 1 was verbalizing less pain and fatigue while

writing. Moreover, the therapist noted that others could now more easily read Participant 1's writing. Though both self-reported and therapist-reported scores showed a decrease in problems associated with handwriting proficiency, these score differences were not significant enough to reject Null Hypotheses 7 and 8. These findings will be discussed in greater depth in Chapter 5.

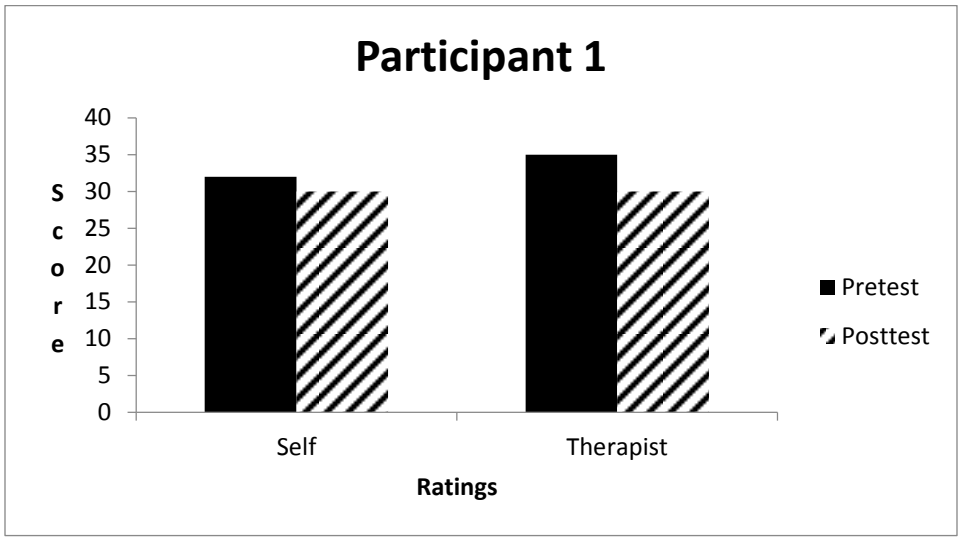


Figure 2. Participant 1's proficiency data.

Participant 2. Participant 2's pretest self-report score on the HSPQ-C was 31 out of 40. His posttest score had decreased by 3 points to 28. Participant 2 endorsed a decrease in the difficulty he has when reading his own handwriting. He also reported that, following the intervention, he complained less about pain when writing. Therapist's ratings on the HSPQ indicated a decrease of 6 points from a pretest score of 33 to a posttest score of 27. Therapist's report indicated that it was now easier to read Participant 2's handwriting. The therapist also reported that Participant 2 erased less during writing tasks. Participant 2's self-reported score showed a decrease in problems

associated with handwriting proficiency, but this score difference was not significant enough to reject Null Hypothesis 7. Alternatively, therapist ratings demonstrated a 6 point decrease in problems associated with handwriting proficiency. This met the qualification for rejecting Null Hypothesis 8 and accepting Alternative Hypothesis 8. These findings will be discussed more in Chapter 5.

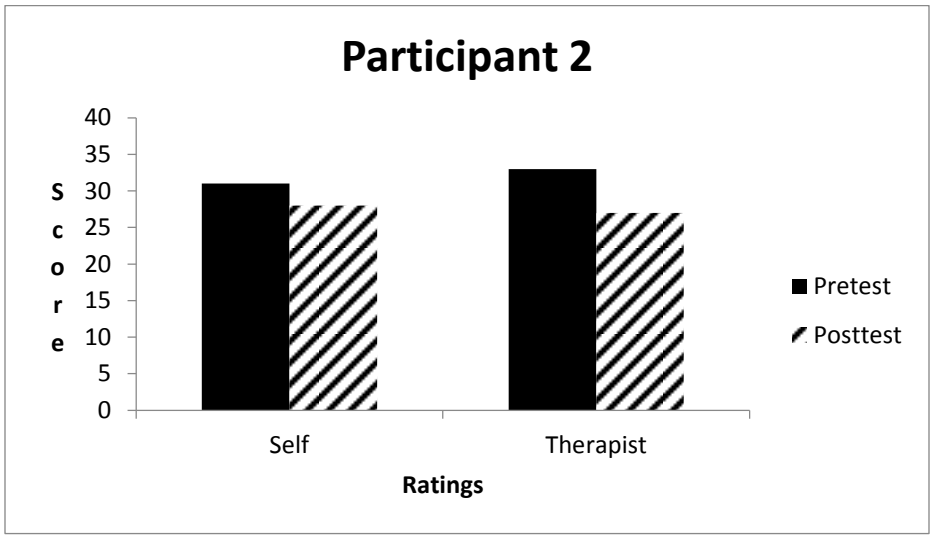


Figure 3. Participant 2's proficiency data.

Participant 3. Participant 3's pretest self-report score on the HSPQ-C was 37 out of 40. His posttest score decreased by 4 points to 33. Participant 3 reported that he was erasing less and tiring less quickly when engaging in writing tasks. He also reported an increase in the ease with which he could read his own writing. Therapist's ratings on the HSPQ indicated a decrease of 6 points from a pretest score of 37 to a posttest score of 31. The therapist reported that Participant 3's handwriting had become easier to read following the intervention. He also noted that Participant 3 was verbalizing less pain and fatigue while writing. Participant 3's self-reported score showed a decrease in problems

associated with handwriting proficiency, but this score difference was not significant enough to reject Null Hypothesis 7. Alternatively, therapist ratings demonstrated a 6 point decrease in problems associated with handwriting proficiency. This met the qualification for rejecting Null Hypothesis 8 and accepting Alternative Hypothesis 8. These findings will be discussed in greater detail in Chapter 5.

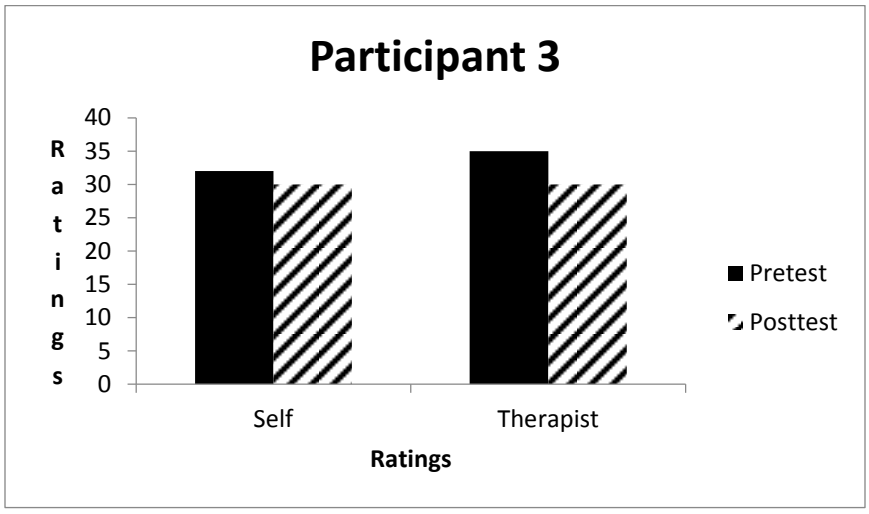


Figure 4. Participant 3's proficiency data.

Social Validity

The Social Validity Research Questions examined the acceptability of the treatment and investigated whether the therapist and the participants found the VSM treatment to be an acceptable intervention within a day treatment center setting for handwriting difficulties in children with ASD. Research Question 9 focused on the therapist's perceptions of the use of VSM and used the modified BIRS to draw conclusions about its acceptability. The DTC supervisor administered the modified BIRS to the therapist participant. The modified BIRS contains 23 items and uses a 1-6

(strongly disagree-strongly agree) Likert based system to determine the social validity of the intervention (Martens et al., 1985). The total score on the profile can range from 23-138 with higher scores suggesting a greater acceptability of the intervention (Dieker et al., 2009). In this research project, the mean score out of all 23 items was used to examine the validity of the treatment. Mean scores at or above 4 were identified to represent acceptability of the treatment (Cihak, Alberto, & Fredrick, 2007). The data from the therapist's modified BIRS can be found in Table 8.

Table 2

Modified Behavior Intervention Rating Scale (BIRS)

Reviewer	Raw Score	Mean Score
Therapist	101	4.391

The therapist participant endorsed the modified BIRS with a raw score of 101 and a mean score of 4.391. This mean score is higher than the acceptability mean of 4, indicating that the therapist participant found the VSM intervention to be acceptable for use within a day treatment center setting. Null Hypothesis 9 should be rejected. Specific interpretations of the therapist's report will be discussed in Chapter 5.

Research Question 10 investigated whether the participants would rate the VSM intervention as an acceptable treatment to receive within a day treatment center setting by scoring the modified (CIRP) at a level of 4 or higher. The DTC supervisor administered the modified CIRP to the participants. The modified CIRP contains seven items with responses ranging from 1-6 (strongly disagree-strongly agree) Likert based system to rate

the social validity of the intervention (Martens et al., 1985). The total scores can range from 7-42 with higher scores suggesting a greater acceptability of the intervention (Lane et al., 2009). This research project used the mean scores of all rated items to identify the level of treatment validity. Mean scores at or above 4 are considered acceptable (Cihak, Alberto, & Fredrick, 2007). The data from the modified CIRP can be found in Table 9.

Table 3

Modified Children's Intervention Rating Profile (CIRP)

Reviewer	Raw Score	Mean Score
Participant 1	31	4.49
Participant 2	35	5
Participant 3	29	4.14
Average	31.67	4.54

All three participants' scored the modified CIRP as higher than a mean of 4 points, indicating that they all found the VSM treatment to be acceptable for DTC use as an intervention strategy. Null Hypothesis 10 should be rejected. Participant 1 scored the modified CIRP with a raw score of 31 and a mean score of 4.49. Participant 2 scored the modified CIRP with a raw score of 35 and a mean score of 5. Participant 3 scored the modified CIRP with a raw score of 29 and a mean score of 4.14. A thorough interpretation of the participant's scores on the modified CIRP will be discussed in Chapter 5.

Treatment Fidelity

The DTC provided the student researcher with treatment fidelity data sheets to analyze specific information about the administration of the treatment for each participant. Bellini et al. (2007) recommends the use of specific charts to the administrators supervising the treatment in order to gain a better perspective regarding the fidelity of the treatment across participants. Therapists completed a treatment fidelity data sheet for each participant during their treatment phases documenting if the participant watched the video in its entirety, as well as noting if prompts were needed to encourage the participant to attend to the video. The chart also included a blank section for any additional comments. The data collected by the DTC concerning treatment fidelity is presented in Tables 10, 11, and 12.

Table 4

Participant 1's treatment fidelity chart

Session	Video Watched	Prompts	Comments
Session 1	Yes	Minimal	1 verbal prompt needed
Session 2	Yes	Minimal	No prompts needed
Session 3	Yes	Minimal	No prompts needed
Session 4	Yes	Minimal	No prompts needed
Session 5	Yes	Minimal	1 verbal prompt needed

Table 5

Participant 2's treatment fidelity chart

Session	Video Watched	Prompts	Comments
Session 1	Yes	Minimal	1 verbal prompt
Session 2	Yes	Minimal	No prompts
Session 3	Yes	Minimal	No prompts
Session 4	Yes	Minimal	1 verbal prompt
Session 5	Yes	Minimal	No prompts

Table 6

Participant 3's treatment fidelity chart

Session	Video Watched	Prompts	Comments
Session 1	Yes	Multiple	3 verbal prompts
Session 2	Yes	Minimal	1 verbal prompt
Session 3	Yes	Multiple	3 verbal prompts
Session 4	Yes	Minimal	1 point prompt
Session 5	Yes	Minimal	No prompts

The data collected from the treatment fidelity data sheets revealed that all participants watched the video in its entirety during each treatment session. All of the participants needed at least one prompt throughout the intervention sessions to refocus on the video model. Participant 1 needed one verbal prompt initially and another verbal

prompt during session 5. Participant 2 initially needed one verbal prompt during session 1 and a second verbal prompt during session 4. Participant 3 needed the most prompts, requiring three verbal prompts during the first session, one verbal prompt during Session 2, three verbal prompts during Session 3, and one point prompt during Session 4; Session 5 was completed with no prompting.

Conclusion

Secondary analyses of data provided to the student researcher by the DTC contained within this chapter supported the research questions and hypotheses that were identified for this research project. The results for all three participants displayed varying levels of increase in handwriting legibility. Participants 1, 2, and 3 each significantly increased their handwriting legibility. All participants' legibility data showed a large effect size and high PND, indicating that VSM is an effective treatment for improving handwriting legibility in children with ASD. Similarly significant legibility raw score increases, high PND, and high effect sizes were maintained 4 weeks post-intervention, as measured by data collected during a maintenance period. Pretest/ posttest data indicated that all three participants decreased their level of difficulty associated with handwriting proficiency, though only the therapist ratings for Participants 2 and 3 met the cutoff criteria of decreasing these scores by at least 6 points. The social validity of the VSM treatment was established by the therapist participant and Participants 1, 2, and 3 based on ratings of the modified *BIRS* and *CIRP*, respectively. Treatment fidelity logs provided to the student researcher indicated that all participants watched the videos during each

session, often with minimal to no prompting. These findings will be discussed more thoroughly and interpreted in Chapter 5.

Chapter 5 will summarize the entire research project, outline the limitations of the study, and provide recommendations for future research with VSM in the fields of psychology and education. Chapter 5 will also present a discussion about how these findings on the use of VSM treatment in DTC settings can have an impact on our society and our mission to promote social change.

Chapter 5: Discussion

Introduction

The primary objective of this study was to determine if video self-modeling (VSM) could improve the handwriting legibility and proficiency of three child participants with autism spectrum disorder (ASD). To reach this objective, secondary data was obtained from a DTC specializing in applied behavioral analysis (ABA) treatment of children with developmental disabilities. Data were collected by DTC staff during standard operating procedures to examine the effects of VSM treatment on handwriting legibility and proficiency. Changes in legibility between baseline, intervention, and maintenance phases were measured by daily raw score probes assessing the target skill of writing three words taken from the Woodcock Johnsons Tests of Achievement – 3rd Edition (WJ-III ACH) Handwriting Legibility Scale (the participant's name, "cat," and "apple." Proficiency was measured through a pretest/posttest design utilizing participant and therapist ratings from the Handwriting Screening Proficiency Questionnaire (HSPQ) and Handwriting Screening Questionnaire for Children (HSPQ-C). Data also provided information on the social validity surrounding the use of VSM in a DTC setting, as well as contributing to the scientific body of knowledge surrounding the effectiveness of VSM by determining its value as a treatment for handwriting problems in children with ASD.

Chapter 5 provides a summary of the results presented in the previous chapter. Data summaries include the raw score difference in legibility levels across phases for each participant, pretest/ posttest proficiency data, and social validity data obtained

through the modified Behavior Intervention Rating Scale (BIRS) and the modified Children's Intervention Rating Profile (CIRP). Interpretations of the legibility and proficiency results for each participant, including treatment fidelity, and the social acceptability of implementing this type of intervention in a DTC setting, will be discussed. Limitations of the study will be identified. Areas of future research that may address these limitations will also be included. Finally, the chapter concludes with an exploration of the impact of the use of VSM in children with ASD exhibiting handwriting difficulties on social change.

Summary of Results with Interpretations

Overview of Results

Secondary data provided by DTC staff utilizing a multiple baseline across participants design was analyzed to determine if children with ASD could increase their handwriting legibility and proficiency through the use of a VSM treatment program. Three participants, ages 7-8 years, were selected by the DTC supervisor to receive a VSM treatment program. To qualify to receive the VSM treatment, participants had to (a) have obtained a previous diagnosis of autism spectrum disorder, (b) be between the ages of 7 and 9 years old, (c) be able to attend to a video, (d) have verbal communication skills, (e) have self-recognition capabilities, (f) have imitation skills, and (g) have significant difficulty with handwriting.

Data were collected by DTC staff until a relatively stable baseline was achieved. The intervention was implemented after 5 days of baseline data collection for Participant 1, 8 days of data collection for Participant 2, and 11 days of baseline data for Participant

3. Before beginning the intervention, a video was created for each participant that was approximately 2 minutes in length and depicted the participant hearing the instructions ("write your name," "write the word cat," "write the word apple") and writing the word smoothly and correctly. Verbal prompts and point prompts were used to increase attention as necessary; these prompts will be discussed in greater detail below.

The intervention phase lasted 5 days for each participant. The maintenance phase began 4 weeks after the conclusion of the intervention and also lasted for 5 days. Additionally, a pretest/posttest was issued before the baseline data was collected and after the maintenance phase data had been collected. These scores determined handwriting proficiency and are discussed in more depth below. Social validity measures were gathered from one therapist participant and each of the three child participants to determine the perceived level of acceptability of implementing this intervention within a DTC setting. The social validity data are explored in detail below.

Legibility

Participants between the ages of 7 and 8 years were found to exhibit increasing levels of handwriting legibility following the implementation of VSM treatment. Additionally, all participants maintained this increase in legibility 4 weeks posttreatment. The treatment phase research question examined whether the VSM intervention had an effect on the participant's handwriting legibility. In order to reject the null hypotheses for the treatment phase research question, the participant must have demonstrated an increase of at least 10 points when writing his or her name, the word "cat," and the word "apple," as measured by daily target probes. The maintenance phase research question

examined whether the participant maintained the intervention level of performance 4 weeks post-treatment. In order to reject the null hypothesis of the maintenance phase research question, the participant must have maintained at least a 5 point increase of performance over his or her baseline performance.

The data obtained from the DTC were analyzed using visual analysis, percentage of non-overlapping data points (PND), levels of performance, and effect size (ES). PND scores were calculated by counting the number of treatment or maintenance scores that exceeded the highest baseline score, which was then converted to a percentage and used to accept or reject the null hypotheses for research questions 1 and 2. The ES was calculated using Cohen's *d* and reported within the data analysis in order to provide additional information regarding the effectiveness of the treatment for each participant.

Participant 1. As described in Chapter 4, Participant 1 was an African American girl, age 7 years, 3 months at the start of data collection. She was diagnosed at age 4 with ASD Level 2, indicating that her severity level would require substantial support. Participant 1 exhibited marked deficits in verbal and nonverbal social communication skills. She had been enrolled in the DTC for approximately 18 months at the start of treatment. Her total language skills were reported at an approximately 5 year-old level, and the goal was for her to enter an integrated second-grade classroom within the next year.

As shown in Figure 1 in Chapter 4, Participant 1 made significant progress as a result of the VSM treatment. She began to respond to treatment almost immediately. A trend of increasing legibility was observed when comparing Participant 1's baseline data

to her intervention data, moving from a low to moderate level. Participant 1's legibility baseline mean was 9.8. Following treatment, her performance mean increased to 24.2. These data were enough to surpass the 10 points necessary to reject the null hypotheses for the treatment phase research question and accept alternative hypothesis 1, 2, and 3. Moreover, Participant 1's legibility PND from baseline to intervention was calculated at 100% and the ES was 11.6, indicating a large effect size.

Participant 1 maintained her increase in legibility during the post treatment phase. Her level of performance remained at the treatment level of 24.2 during the maintenance phase. This was also a significant enough increase to reject the null hypotheses for the maintenance phase research question and accept alternative hypotheses 4, 5, and 6. Further support for the effectiveness of the treatment for Participant 1 can be seen in analysis of her baseline to maintenance PND score, which was calculated at 100%, as well as her ES of 11.6, which indicated a large effect. Participant 1 responded well to treatment, and was able to maintain her gains at least 4 weeks after the conclusion of treatment.

Treatment fidelity records indicated that Participant 1 watched the video daily during the treatment phase with minimal prompting. She only required two verbal prompts of "look at the video" to re-engage her attention. The first prompt was during session 1 and the second prompt was during the final treatment session, session 5. These two prompts were considered to be minimally intrusive, but were still helpful for promoting Participant 1's attention, thus likely having a positive effect on overall

treatment effectiveness. According the results obtained in this study, VSM was found to be an effective way to improve Participant 1's legibility.

Participant 2. Participant 2 was a Caucasian boy, age 7 years, 1 month. He was diagnosed at age 3 with ASD Level 1, indicating that his severity level would require support. Without support, Participant 2 exhibited noticeable impairments in verbal and nonverbal social communication skills. He had been enrolled in the DTC for approximately 14 months at the start of treatment. His total language skills were reported at an approximately 6 year-old level, and the goal was for him to enter an integrated 2nd grade classroom within the next year.

As presented in Figure 1 in Chapter 4, Participant 2's mean baseline level of performance was calculated at 15.62. During the treatment phase, Participant 2's average legibility score increased to 27.2. Participant 2 improved his mean score by 11.58 points from baseline to intervention, indicating that the criterion was met to reject null hypotheses 1, 2, and 3. A trend of increasing legibility was observed when comparing Participant 2's baseline data to his intervention data, moving from a low to moderate level. Participant 2 also began to respond to the intervention immediately following Session 1 of the intervention. Participant 2's PND from baseline to treatment was calculated at 100%, indicating a very effective level of treatment; ES offered further support of treatment efficacy with a large effect size (12.47).

During the maintenance phase, Participant 2's average baseline level of performance was calculated at 15.62. His average maintenance level of performance was calculated at 24.6. Participant 2 maintained an increase of 8.98 points, higher than the

minimum 5 points necessary for rejecting null hypotheses 4, 5, and 6. Participant 2's maintenance data further indicated that he maintained his level of handwriting legibility with a PND score of 100%. This classified the treatment as highly effective with a large effect size of 12.47. Participant 2 responded well to treatment and was able to maintain his gains for at least 4 weeks after the conclusion of treatment. Similar to what was observed with Participant 1, VSM was found to be an effective way to improve Participant 2's legibility.

Treatment fidelity records indicated that Participant 2 watched the video daily during the treatment phase with minimal prompting. He also required only two verbal prompts of "look at the video" to re-engage his attention. The first prompt was during session 1 and the second prompt was during treatment session 4. The two prompts were as minimally intrusive as possible while still working to increase Participant 2's attention. His high level of attention likely had a positive effect on overall treatment effectiveness. According the results obtained in this study, VSM was found to be an effective way to improve Participant 2's legibility.

Participant 3. Participant 3 was a Caucasian boy who was 8 years, 1 month old. He was diagnosed at age 5 with ASD Level 2, indicating that his severity level would require substantial support. Participant 3 exhibited marked deficits in verbal and nonverbal social communication skills. He had been enrolled in the DTC for approximately 23 months at the start of treatment. His total language skills were reported at an approximately 6 year-old level, and the goal was for him to enter an integrated 2nd grade classroom within the next year.

As shown in Figure 1 in Chapter 4, Participant 3 also began to respond to the intervention immediately following Session 1 of the intervention. Participant 3's average baseline level of performance was calculated at 5.54, while his intervention phase level of performance was calculated at 16. This indicates an increase of 10.46 points from baseline to intervention phase, surpassing the minimum criterion of 10 points necessary for rejecting Null Hypotheses 1, 2, and 3. A trend of increasing legibility was observed when comparing Participant 3's baseline data to his intervention data, increasing from a low to moderate level of response. Furthermore, Participant 3's PND from baseline to intervention score was calculated at 100%, indicating the effectiveness of VSM treatment for this participant. Participant 3's baseline to intervention legibility had an effect size of 10.06, indicating a large effect size.

The Maintenance Phase Research Question investigated whether the participant could maintain at least a 5 point raw score increase once the VSM treatment had been removed for four weeks. Participant 3's average baseline level of performance was calculated to be 5.54, while his maintenance level of performance was calculated at 19.2. These scores demonstrated not only maintenance of skills after the 30 day period without treatment, but, in fact, a strengthening of skills, by 13.66 points between baseline and maintenance phase. This surpasses the criterion of 5 points necessary to reject Null Hypotheses 4, 5, and 6. Additionally, analysis of Participant 3's baseline to maintenance data showed that his PND score was calculated at 100% and the ES was 13.87, further providing evidence of the effectiveness of VSM is a treatment for improving the handwriting legibility of this participant. Participant 3 began to respond to the

intervention immediately following Session 1 of the intervention and was able to maintain his gains for at least 4 weeks after the removal of treatment.

Treatment fidelity records indicated that Participant 3 watched the video daily during the treatment phase. During session 1, he needed multiple verbal prompts. Therapists used the same verbal prompt as used with Participants 1 and 2 ("look at the video"). By session 2, he only needed 1 verbal prompt. Session 3, however, again required the use of multiple verbal prompts. Session 4 required only one point prompt (therapist pointed to the video) and the final session required no prompts. This demonstrates a strengthening of attention skills, which may have a positive relationship with his demonstrated increase of legibility during the maintenance phase. As he learned to pay closer attention to the video, his handwriting legibility continued to increase. Similar to the result findings of Participants 1 and 2, VSM was found to be an effective way to improve Participant 3's legibility. The results of this study demonstrate that VSM appears to be an effective treatment for increasing the legibility of all participants.

Summary of Legibility. The primary dependent variable in this study was handwriting legibility. The data was analyzed to examine the relationship between VSM and handwriting legibility. It was hypothesized that a positive increase would be observed in the legibility ratings of participants after the implementation of a VSM treatment. These hypotheses were accepted across all participants with significant increases observed in raw score ratings. Additionally, PND analysis was measured at 100% for all participants. Cohen's *d* showed a large effect size across all participants. Moreover, all participants showed an almost immediate response to treatment.

Participant 3 even continued to improve his legibility scores after treatment was removed. This suggests that VSM may be a good way to improve a child's attention to learning and increase feelings of self-efficacy, which may contribute to improved handwriting skills. Previous research has reported similar efficacy findings for VSM concerning the increase of task engagement (Cihak, Wright, & Ayers, 2010) and task fluency (Lasater & Brady, 1995). Additionally, Boudreau and Harvey (2013) determined that VSM increased recreational initiation with peers in a sample of three children with ASD, and that these results lasted through a maintenance phase that occurred 2 weeks post-intervention. The present research study further adds to this scientific body of knowledge surrounding the usefulness of VSM for improving skill functioning in children with ASD.

As handwriting was the focus of a daily treatment session, it is possible that practice effects had a positive impact on participants' skill level. Due to the multiple baseline design and the stability of each participant's score, it is unlikely, however, that practice effects alone would not be enough to show this level of improvement. Instead, it is hypothesized that once the participant begin to experience these feelings of self-efficacy and better understand the requirements of the task, the practice became more efficacious, helping to propel the participants even further. While practice is often a useful way of improving skills, it appears to be important to have a clear understanding of the ultimate goal in order to show significant steady improvement. VSM was shown to be an effective treatment for increasing Participant 1, 2, and 3's ability to legibly construct his or her name, as well as the words "cat" and "apple."

Proficiency

Participant 1. Participant 1's pretest self-report score on the HSPQ-C was 32 out of 40 points. Her posttest score had decreased by 2 points to 30 points, indicating a decrease in problems associated with handwriting proficiency. Participant 1 initially endorsed that others "always" have difficulty reading her handwriting, while she later lessened this assertion to "often." She also reported a decrease in the frequency of erasing during a writing task from "always" to "often." Therapist's ratings on the HSPQ indicated a decrease of 5 points from a pretest score of 35 to a posttest score of 30. The therapist reported that Participant 1 initially verbalized pain "often" while writing, but verbalized this pain "rarely" posttreatment. Fatigue while writing was reported to decrease from "often" to "sometimes." Moreover, the therapist noted that others could now "often" read the child's writing as opposed to "never." The participant felt that she was erasing less. The participant and therapist participant also reported a positive change in the appearance and readability of Participant 1's writing posttreatment. The self-reported and therapist-reported scores showed a decrease in problems associated with handwriting proficiency posttreatment. Both participants noted the writing process was now easier, with less pain and fatigue. Despite these gains, these score differences were not quite high enough to reject null hypotheses 7 and 8, however.

Participant 2. Participant 2's pretest self-report score on the HSPQ-C was 31 out of 40 points. His posttest score had decreased by 3 points to 28 points, indicating a decrease in problems associated with handwriting proficiency. Participant 2 reported that initially, he was only "sometimes" able to read his own handwriting. Following treatment, he felt that he was "often" able to read his writing. Before treatment, he

complained “often” about writing, while after the intervention, Participant 2 noted that he only complained “sometimes.” Moreover, while Participant 2 had reportedly “never” been satisfied with his writing pretreatment, he was now “often” expressing satisfaction. Therapist’s ratings on the HSPQ indicated a decrease of 6 points from a pretest score of 33 points to a posttest score of 27 points. Therapist’s report indicated that while it had initially “often” been hard to read Participant 2’s handwriting, this difficulty now “rarely” occurred. The therapist also reported that Participant 2 erased less during writing tasks, dropping from “sometimes” to “rarely.” The therapist commented on the form that Participant 2 now seemed eager to engage in writing tasks, whereas he had previously avoided them. Participant 2’s self-reported score showed a decrease in problems associated with handwriting proficiency, but this score difference was not significant enough to reject null hypothesis 7. Alternatively, therapist ratings demonstrated a 6 point decrease in problems associated with handwriting proficiency. This met the qualification for rejecting null hypothesis 8 and accepting alternative hypothesis 8. Similar to Participant 1, there was progress observed by both reporters. Despite this, only the therapist reporter indicated a significant change.

Participant 3. Participant 3’s pretest self-report score on the HSPQ-C was 37 out of 40 points. His posttest score decreased by 4 points to 33 points, indicating a decrease in problems associated with handwriting proficiency. Participant 3 reported that his erasing has decreased from “often” to “rarely” when engaging in writing tasks. Participant 3 also reported that he could now “often” read his read his own writing, whereas he had previously reported his ability to read his writing as “rarely” occurring.

Participant 3 also noted less fatigue while writing, reducing his score from an experience of "always" to "sometimes." Therapist's ratings on the HSPQ indicated a decrease of 6 points from a pretest score of 37 to a posttest score of 31. Therapist reports indicated that others were now able to "often" read Participant 3's handwriting, as opposed to the initial pretest report of "never." Participant 3 now complained to the therapist of pain while writing less often, decreasing from a report of "always" experiencing pain to only experiencing pain "sometimes," Participant 3's self-reported score showed a decrease in problems associated with handwriting proficiency, but this score difference was not significant enough to reject null hypothesis 7. Alternatively, therapist ratings demonstrated a 6 point decrease in problems associated with handwriting proficiency. This met the qualification for rejecting null hypothesis 8 and accepting alternative hypothesis 8.

Summary of proficiency. Proficiency was demonstrated as improving across all participants, as evidenced by a decrease in scores of problem behavior associated with handwriting. However, only Participant 2 self-reported a significant increase in proficiency ratings. Therapist ratings for all three participants also showed an increase in proficiency, though only Participant 2 and 3's scores were significant enough to reject the null hypothesis. One reason for this finding may be due to deficits in self-awareness that are often associated with ASD (Mundy & Newell, 2007). Additionally, the participants were only 7 and 8 years old. Children of this age may have more difficulty accurately reporting symptoms, especially when asked about the frequency of problem behaviors (Beyer, McGrath, & Berde, 1990); adult therapists may prove a better source of

information. The children were able to verbalize that they felt that the handwriting process was easier and less painful. They reported less mistakes and less erasing when writing. All participants believed their handwriting to be more legible following the treatment. However, they had some difficulty translating those beliefs into concrete numbers on a self-report scale, which is understandable. Moreover, the children have a long standing history of handwriting problems. Those this treatment is believed to have increased feelings of self-efficacy, some of these beliefs about their abilities may be hard to move beyond. The therapists, who are trained to be more objective in their observation of the children's behavior, may be a better source of information. It is also possible that the sensitivity of the HSPQ-C was not sufficient to detect the positive changes in proficiency. The impact of instrumentation is discussed further within the limitations section below.

The significant findings from two of the three therapists, in addition to a decrease in reported problems by all participants, represent satisfactory evidence in support of an increase in handwriting proficiency for these children. The increase in handwriting proficiency observed in the present research study, though not consistently significant, supports previous research which has also shown an increase in the skills of children with ASD following VSM treatment (Boudreau & Harvey, 2013; Cihak, Wright, & Ayers, 2010; Lasater & Brady, 1995). VSM was found to be associated with an increase in skill level and decrease in handwriting problems in this current research, thus offering a helpful contribution to the scientific body of knowledge supporting the efficacy of VSM.

Social Validity

This study also sought to gain validation for the efficacy of video based interventions (VBIs) such as VSM for use within a DTC setting. The Social Validity Research Questions investigated the therapist's and the participants' views of VSM treatment for handwriting difficulties in children with ASD within a day treatment center setting. Research Question 9 focused on the therapist's perceptions of the use of VSM by using the modified BIRS to draw conclusions about its acceptability. The DTC supervisor administered the modified BIRS to the therapist participant. As discussed previously, the modified BIRS contains 23 items and uses a 1-6 (strongly disagree-strongly agree) Likert based system to determine the social validity of the intervention. Scores on the profile range from 23-138 points; higher scores suggest a greater acceptability of the intervention. This research utilized the mean score out of all 23 items to examine the validity of the treatment with mean scores at or above 4 representing acceptability of the treatment.

This study found that the therapist participant endorsed the modified BIRS with a raw score of 101 and a mean score of 4.391. This mean score is higher than the acceptability mean of 4 (Elliot & Treuting, 1991) indicating that the therapist participant found the VSM intervention to be acceptable for use within a DTC setting, thus supporting the rejection of null hypothesis 9. Specifically, the therapist endorsed that she "strongly agreed" that most therapists would find video modeling an appropriate way to address skill deficits. The therapist further reported that she "strongly agreed" that she would recommend VSM to other DTC therapists. The therapist also agreed that VSM would improve clients' skills to the point that it would prepare them for a regular

classroom, which is the ultimate goal of treatment. Conversely, the therapist participant reported some hesitation regarding her beliefs on the generalizability of VSM treatment to other children in the DTC. She "slightly disagreed" with the statement "Video self-modeling would be an appropriate intervention for a variety of clients." It is worth noting that these participants were reported to be higher-functioning than many of the other clients in the center, which could account for the therapist's concerns that VSM might not be appropriate for all clients. However, given the positive results found within this study, this may be a useful area for future research. This idea will be discussed in more depth below. Overall, the therapist participant found VSM to be an acceptable treatment to utilize within a DTC setting.

Research question 10 investigated whether the participants would rate the VSM intervention as an acceptable treatment to receive within a DTC setting. The DTC supervisor administered the modified CIRP to the participants. The modified *CIRP* contains seven items with responses ranging from 1-6 (strongly disagree-strongly agree) on a Likert based system to rate the social validity of the intervention (Martens et al., 1985). The total scores can range from 7-42 points, and higher scores suggesting a greater acceptability of the intervention (Dieker et al., 2009). The mean score of all rated items was used to identify the level of treatment validity. Similar to therapist ratings on the *BIRS*, mean scores at or above 4 are considered acceptable (Cowan & Sheridan, 2003).

All three participants' scored the modified CIRP as higher than a mean of 4 points. This demonstrated that all three participants found the VSM treatment to be an

acceptable treatment to receive at the DTC. Therefore, Null Hypothesis 10 should be rejected. Participant 1 scored the modified CIRP with a raw score of 31 and a mean score of 4.49. Participant 2 scored the modified CIRP with a raw score of 35 and a mean score of 5. Participant 3 scored the modified CIRP with a raw score of 29 and a mean score of 4.14. Interestingly, given that the participants' proficiency scores did not indicate significant positive changes, all three participants strongly agreed that the VSM treatment had helped his or her handwriting. This may be because the proficiency self-report assessment (HSPQ-C) asked participants more detailed questions, while the CIRP inquired as to the general level of helpfulness of VSM for treating handwriting difficulties. When seeking information from developmentally delayed children ages 7 and 8, more general questions may elicit more positive responses than would detailed questions, which may be more difficult to understand. This information may be explored more in future research in order to help inform the best ways to gather self-report information from children.

Participant 1 "strongly agreed" that the use of VSM was fair, while Participants 2 and 3 only "agreed" with this statement. Participant 2 "strongly agreed" that VSM would help him learn to write other words, as well; Participant 1 "agreed" with this, while Participant 3 "slightly disagreed." Participant 3 "strongly agreed" that it would be good for his therapist to use VSM with other kids at the DTC. Participant 1 "agreed" with this, and Participant 2 "slightly agreed." All three participants only "slightly agreed" that VSM may be helpful for learning other skills within a DTC setting. This could be attributable to the known deficit individuals with ASD have in cognitive flexibility

(Geurts, Corbett, & Solomon, 2009). Though they can express their belief in VSM as an effective treatment for dysgraphia, they may have more difficulty applying this concept to other skill deficits. Despite this, all three participants reported positive experiences with VSM and found VSM to be an acceptable treatment to receive within a DTC setting.

Summary of Social Validity. When examining the overall level of acceptability of VSM treatment within a DTC setting, it was found that both therapists and participants agreed. All participants questioned indicated that VSM would be an appropriate treatment to receive within this type of setting. Null hypotheses 9 and 10 were rejected. Though some hesitancy was expressed concerning the applicability of VSM for other skill deficits and with other clients, given the positive effects demonstrated within this study, conducting further research in these areas may prove beneficial. This research found that VSM is a well-received treatment for remediating dysgraphia within a DTC setting.

Implications of Results

Taking the results summarized thus far as a whole, it seems reasonable to conclude that VSM is a well-received and effective treatment for remediating dysgraphia within a DTC setting. VSM demonstrated a significant improvement in legibility ratings across all three participants. To calculate this number, two therapists jointly calculated a numerical raw score based on the WJ-III ACH Handwriting Legibility Scale for each session. Data showed significant improvement from baseline to treatment phase, with continued, or even enhanced, improvement during the maintenance phase. Proficiency scores showed similar, though not always significant, improvement across all

participants. Finally, social validity reports indicated that both therapists and participants found VSM to be an effective treatment for improving handwriting deficits in children with ASD within a DTC setting.

Because handwriting difficulties are so common among children with ASD (Kushki, Chau, & Anagnostou, 2011), finding an effective way to remediate this deficit is important. Children with ASD may be difficult to treat because they do not always respond to the teaching environment in the same way that neurotypical children may (Koegel & Koegel, 1995). Therefore, helping these children in a manner that is effective, but not aversive to them is essential. VSM appears to meet both criteria. The effectiveness and acceptability of the treatment shows promise. It will be useful to expand upon this research and determine the generalizability of these findings to other individuals and for the treatment of other deficits.

This study aimed to contribute to the scientific body of knowledge regarding the use of VSM, specifically within an ASD population. The level of increase in handwriting legibility and proficiency observed in the present research study is consistent with previous research, which has also shown an increase in the skills of children with ASD following VSM treatment (Boudreau & Harvey, 2013; Cihak, Wright, & Ayers, 2010; Lasater & Brady, 1995). Task fluency and task engagement have been shown to improve following VSM treatment. Children with ASD have shown more independent social initiation with peers. VSM has previously demonstrated efficacy as a treatment for this population. This research study further contributed to this evidence. VSM appears to have good utility within an ASD population.

Limitations

Four significant limitations were found within this research. First, though some participant differences were evident, the similarity between participants was quite high, potentially hindering the generalizability of the results. Second, the focus of the study was limited in scope to writing only three specific words. Third, the instrumentation used to measure score changes lacked strong validity data. Finally, the presence of extrinsic factors such as at-home practice could potentially have impacted results. These limitations will be discussed individually below.

Participant similarity

Because the three participants in this research sample were all drawn from one DTC, many similarities could be found among them. As discussed previously, most of the children who attend this DTC live in urban Houston, Texas. They tend to be from wealthier families who can afford full-time treatment for their children. They often have the resources necessary to spend the requisite amount of time in therapy with their children, receiving parent training and participating in the learning process. Beyond this, the DTC supervisor imposed certain criteria for participation, further increasing the similarities between participants. Participants had to be able to attend to a video, had to be between 7 and 9 years old, and had to basic verbal and imitation skills. As such, no individuals diagnosed with Level 3 ASD met the criteria. Diversity was encouraged, however, by using both male and female participants, as well as including participants who were both African American and Caucasian. The age of the participants was between 7 and 8 years old. Participants who had received diagnoses of both Level 1 and

Level 2 ASD were included. Thus, while there was some noted homogeneity among participants, individual differences were also observed, thus promoting a greater generalizability of results. Future research, however, may wish to address this issue by replicating research procedures with a broader range of participants.

Limited focus

A second potential limitation noted in this research was the highly specified focus. To determine if VSM may be a useful treatment procedure for remediating dysgraphia in this population, three words were chosen from the WJ-III ACH Handwriting Legibility Scale. This allowed the researcher to then compare the writing of those words with the scoring template found in the back of the WJ-III ACH manual for a more direct comparison. However, though "cat" and "apple" are both common words, they may not be as useful to the child as learning to write their last name, for example. Writing only the participant's first name was chosen as a way to eliminate the confusion of having one multiword target and two single word targets. While this was likely the best choice for this research project, future research may want to expand upon these findings by studying a wider variety of words.

Instrumentation

A third potential limitation of this research was related to the chosen instrumentation. The HSPQ and HSPQ-C are both relatively new instruments that were made available for this research only through written permission from the author. Validity and reliability for the HSPQ (Rosenblum, 2008) and HSPQ-C (Rosenblum & Gafni-Lachter, 2015) were both confirmed by the researcher. Findings indicated that the

HSPQ-C demonstrated good internal consistency (α=.77). Concurrent validity was also established between the HSPQ and the HSPQ-C (r=.51, $p < .001$). Construct validity was confirmed using confirmatory factor analysis. Analysis showed that the *HSPQ* and the HSPQ-C distinguished between children with and without handwriting deficiencies (Rosenblum, 2008; Rosenblum & Gafni-Lachter, 2015). However, no external reporting of validity or reliability was yet available. These instruments show good promise, but still require more research to expand upon this validity data. Additionally, research on the validity within the ASD population might prove to be particularly useful, as individuals with ASD often report significant handwriting difficulties (Kushki, Chau, & Anagnostou, 2011). The HSPQ and HSPQ-C also may not be sensitive enough to detect subtle improvements in handwriting proficiency as detailed earlier.

The WJ III-ACH did not report specific validity ratings. Though the WJ-III ACH is a standardized, nationally norm-referenced achievement test with a reported median score of *.75* for 3rd grade respondents, content validity was reported only through a comparison with the core curricular areas specified in federal legislation (McGrew & Woodcock, 2001). No specific validity scores were reported for the WJ-III ACH. . A high level of interrater reliability was reported for the Handwriting Legibility Scale, but no numerical validity was reported.

Extrinsic Factors

The potential influence of extrinsic factors was also considered as a possible limitation. Handwriting activities are ubiquitous, and though DTC staff were reportedly instructed to refrain from engaging participants in any handwriting activities occurring

outside the parameters of the study, it is possible that participants' family members engaged in handwriting practice with the children during home hours.

Recommendations for Future Research

Future research suggestions involve finding ways to expand upon these findings and address the limitations discussed above. A good first step might be to replicate the original DTC study using a different sample. A similar sample would help to strengthen the findings found within this study, while a more diverse sample would promote greater generalizability of results. Both approaches would likely create useful data. Moreover, conducting similar research that expands upon the words used in this study might be helpful, as well. This study looked at the utility of a VSM treatment for improving the writing of his or her name, the word "cat," and the word "apple." While these words are common and useful, there is a ripe opportunity to expand upon these skills. Additionally, VSM has proven to be an effective treatment for various skill deficits in the ASD population, such as verbal skills, social deficits, and daily living skills. That combined with the findings from this research suggest that further study into improving the academic skills of children with ASD may be a worthwhile goal. Along these same lines, future research expanding the settings in which VSM is offered may be useful. The social acceptability of VSM was found within a DTC setting, and it would be interesting to see if this level of effectiveness and social validity would be similar across multiple settings, including clinical, educational, and private practice. By increasing this type of research across different participants, skills, and settings, the effectiveness and validity of VSM research may be strengthened.

Implications for Social Change

This research sought to build upon the information surrounding several important issues in today's society. One issue is the increasing importance of and reliance on technology in the current world. The second issue concerns the need for creating strategies to help the growing population of children with ASD become successful adults capable of making positive contributions to society.

To address the first issue of technology, this study utilized technologically advanced, yet still very simple, methods of creating teaching tools aimed at helping children improve their handwriting skills. When VSM first began to rouse the interest of researchers, the process was much more involved, and potentially daunting. Recording devices were not as readily available, more expensive, and more cumbersome to transport. Recordings were made on film, which again cost money and required an individual skilled in working with film. Plus the editing was more rigorous and time consuming. For the current research, however, all that was needed was a simple cell phone with recording capabilities and a free video editing application. Both of these requirements can be easily met through the majority of cellular telephones available today. What that means is that recording and editing VSM videos has never been easier or more cost effective. Not only did this treatment show good efficacy results and high social acceptability, it was also easy to implement. Therefore, it should be similarly easy to train other therapists nationally, and potentially globally, on the best ways to implement this effective treatment with little expenditure.

Addressing the second part of the social change goals of this research, the reasoning behind this research was to improve the writing, and therefore the communication abilities, of children with ASD. This population is growing, with numbers now approaching a staggering 1 in 68 births (Christensen et al., 2016). That is a significant prevalence rate. Thus, helping these children reach their full potential is of pressing concern. The better they are able to function, the more the likely that they will become contributing members of society. Being an integral part of society benefits both the individual, in terms of financial success, health, and emotional well-being, as well as the society in much the same way. A society is composed of individuals, and when those individuals are flourishing, society flourishes.

Children with ASD have specific needs and often learn best in unique ways (Koegel & Koegel, 1995). By contributing to the scientific body of knowledge regarding the most efficacious ways of enhancing the skills sets of children with ASD, a positive outcome is likely for both the individual and society. Creating a unique treatment that can be easily implemented with little cost and high acceptability further promotes these concepts in a wide-reaching way.

Conclusion

Handwriting is a fundamental part of human interaction. From the necessity of signing documents to the social importance of jotting quick notes, it is essential to have basic handwriting skills. Children with ASD often lack this skill, thus limiting their ability to communicate with others. This research project sought to examine if VSM

would be an efficacious and socially acceptable treatment for remediating dysgraphia in a sample of children with ASD.

The theoretical basis for all video based treatment modalities is Bandura's social learning theory (Bandura, 1977). Bandura posited that children imitate what they witness others doing, adjusting their behavior accordingly. The concept of self-efficacy arose from the idea that if an individual had the belief that they could demonstrate a certain skill, their ability to perform that task would be enhanced. VSM uses a technological approach to increase feelings of self-efficacy by creating a video of the individual that has been edited to make it seem as though they can smoothly perform a given target behavior . In other words, if an individual can observe themselves successfully engaging in a behavior, he or she is more likely to believe in their own ability to achieve that success. This idea is the foundation of the VSM that was utilized within this research project.

The overall purpose of this research project was to conduct secondary analyses of data collected by a DTC to determine the effectiveness of VSM on the legibility and proficiency of participants who had previously shown difficulty with handwriting. Results of data presented to the student researcher by the DTC supervisor indicated that VSM was an effective treatment for all three participants. Legibility raw scores were increased, PND scores were found to be 100%, and effect size was large across all participants. Moreover, the treatment worked quickly and gains were maintained at least four weeks posttreatment. Similarly, handwriting proficiency was shown to increase across all participants based on ratings from a pretest/ posttest evaluation, though not all

findings were significant. However, it was evident that VSM demonstrated a positive effect on all three participants' handwriting skills. Further validation for the positive findings of this research was also observed on the treatment fidelity forms that the therapist participant completed for each participant. The fidelity forms noted that all three of the participants were observed to attend to the videos with few verbal and point prompts needed to regain their attention.

The secondary purpose of this research project was to address the social validity surrounding the use of VSM within a DTC setting. All three participants, as well as the therapist participant, reported the treatment as socially valid. Scores used to obtain these conclusions were acquired from the modified BIRS and CIRP that were administered to the therapist and participants by DTC staff. The mean level of the social validity scale for the therapist participant was above the cutoff score signifying treatment acceptability.

This research project demonstrated how incorporating technology into treatment practices can be a successful method for increasing skill deficits in children with ASD. This treatment method can be implemented quickly and easily with minimal technological skills required. This suggests that other facilities may have the capacity to implement this technique globally. Due to the high prevalence rates of ASD in today's world, the need to find effective and acceptable ways of treating these children is pressing. This research is a step in the right direction toward proving VSM as an effective teaching tool for children with ASD. Future research has the potential to expand upon these findings and further promote positive social change. Improving

handwriting skills in children with ASD has the potential to lead to a global improvement in communication.

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Appendix A: Handwriting Legibility Scale

Handwriting

(From Test 11 Writing Samples)

HANDWRITING ELEMENTS: CHECKLIST

Check boxes that are appropriate.

	Needs Improvement	Satisfactory	Excellent
Slant	❑	❑	❑
❑ inconsistent			
❑ too extreme			
Comments:			
Spacing	❑	❑	❑
❑ too wide			
❑ crowded			
❑ poor between letters			
❑ poor between parts of letter			
❑ poor between words			
Comments:			
Size	❑	❑	❑
❑ not uniform			
❑ too big			
❑ too small			
Comments:			
Horizontal Alignment	❑	❑	❑
❑ uneven height			
❑ above the line			
❑ below the line			
Comments:			
Letter Formation	❑	❑	❑
❑ poor general form			
❑ poor loop letters			
❑ letters too thin			
❑ letters too round			
List specific letter formation errors:			
Line Quality	❑	❑	❑
❑ too heavy			
❑ too light			
❑ broken			
❑ shaky			
Comments:			

OVERALL LEGIBILITY

(Based on specimens in Appendix C of the Examiner's Manual)

First rater _____

Optional second rater _____

Rating *(Average if more than one rater)* **(0–100)**

Handwriting Legibility Scale

Scoring Table

Encircle row for the Handwriting Rating.

Rating	AE (Est)*	GE (Est)*
<15	<5-0	<K.0
15	<5-0	K.1
20	5-0	K.3
25	5-8	K.6
30	6-4	1.0
35	7-0	1.5
40	7-8	2.1
45	8-5	2.9
50	9-3	3.9
55	10-5	5.3
60	12-1	7.3
65	16-0	10.3
70	>21	13.0
>70	>21	>18.0

*AE and GE are estimates of the precise values provided by the software scoring program.

Appendix B: Handwriting Legibility Sample Scoring

Appendix C

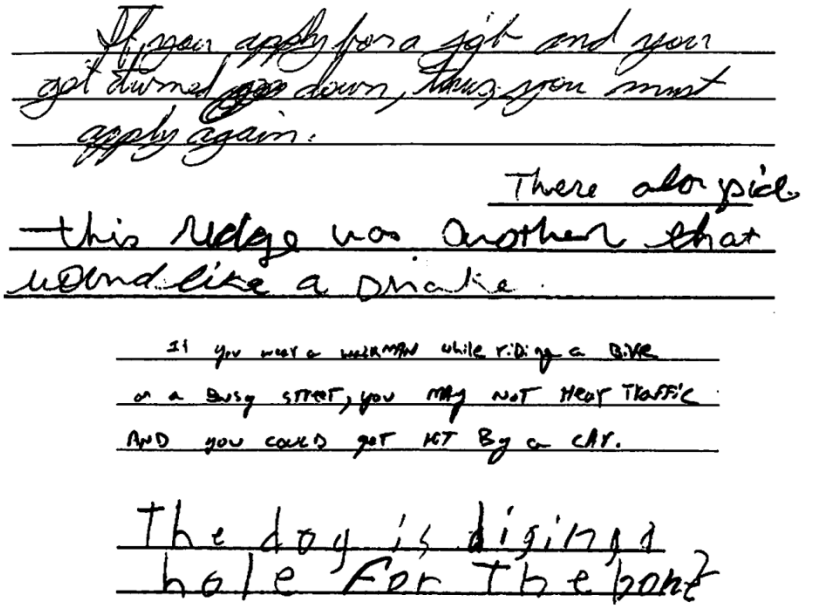
Handwriting Legibility Scale

Select several items that are representative of the subject's handwriting from Test 11: Writing Samples. Compare the sample to the examples provided in this scale. Refer to Chapter 4 for further explanation of the procedures for rating the subject's handwriting. Record the subject's handwriting rating in the Test Record.

Rating	Sample
100	Artistic
90	A bus and a train are alike in two ways; they both have wheels and transport people. It is dangerous to wear a radio because you cannot hear cars. On the weekend, my three favorite things to do are to sleep late, visit with friends, and catch up on my reading. A bus and a train are both means of transportation and they both carry luggage.
80	

Rating	Sample
70	my favorite weekend past times are going out to breakfast, sleeping late, and seeing movies. The businessmen of this firm recomend you, thus you will be hired. As in his dream, a young man in a suit of armer handed him the secret plans for building the atom bomb. The little boy was surpised that he got a new plane for his birthday.
60	
50	The cat is looking at the gold fish and he may eat it. His friend, Rick, also seemed to be eccentric.

Rating	Sample
50	Dad has a flat tire, so he can't go to work for an hour. It is dangerous to dive into a pool if you don't know how deep it is because you might hit the bottom and get hurt.
40	
30	The small boy who found the dog got a banana reward for the dogs' owner. The boy is looking for his shoes and now he is looking under the bed. A balloon is round with air in it to make it rise, and a string tied to it to holder to it, the cat is trying to got the fish then he is going to eat is

Rating	Sample
20	
10	
0	Illegible

Appendix C: Handwriting Proficiency Screening Questionnaire

The laboratory of Complex Human Activity and Participation -(CHAP)
Department of Occupational Therapy
University of Haifa

Handwriting Proficiency Screening Questionnaire (HPSQ) (Rosenblum, 2008)

Child's name _____ School and class _____ Date _____

Please complete the following questionnaire based on your impression of the child's handwriting in your class.

Question	Never 0	Rarely 1	Some-times 2	Often 3	Always 4
1. Is the child's writing unreadable?					
2. Is the child unsuccessful in reading his/her own handwriting?					
3. Does the child does not have enough time to copy tasks from the blackboard?					
4. Does the child often erase while writing?					
5. Does the child often feel he/she does not want to write?					
6. Does the child not do his/her homework?					
7. Does the child complain about pain while writing?					
8. Does the child tire while writing?					
9. Does the child need to look at the page/blackboard often when copying?					
10. Is the child not satisfied with his/her handwriting?					

Appendix D: Handwriting Proficiency Screening Questionnaire for Children

The laboratory of Complex Human Activity and Participation -(CHAP)
Department of Occupational Therapy
University of Haifa

Handwriting Proficiency Screening Questionnaire for Children (HPSQ-C)

(Rosenblum, 2015)

Your name _____ School and class _____ Date _____

Please complete the following questionnaire based on how you feel about your handwriting performance.

Question	Never 0	Rarely 1	Some-times 2	Often 3	Always 4
1. Is your handwriting difficult to read?					
2. Do you have difficulty reading your own handwriting?					
3. Do you not have enough time to copy tasks from the board?					
4. Do you erase a lot while writing?					
5. Do you feel you do not want to write?					
6. Do you *not do* your homework?					
7. Do you complain about pain while writing?					
8. Do you get tired while writing?					
9. Do you need to often look at the page/board when copying?					
10. Are you not satisfied with your handwriting?					

Appendix E: Permission Letter to Use *HSPQ* and *HSPQ-C*

Thank you Geri, both questionnaires with their papers are attached herby
I wish you good luck with your research
Best,
Sara

Prof. Sara Rosenblum
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Appendix F: Behavior Intervention Rating Scale

Please evaluate the intervention by circling the number which best describes agreement or disagreement with each statement. Please circle only one item for each statement.

	Strongly Disagree	**Disagree**	**Slightly Disagree**	**Slightly Agree**	**Agree**	**Strongly Agree**
1. Video self-modeling would be an acceptable intervention to teach academic skills.	1	2	3	4	5	6
2. Most therapists would find video self-modeling an appropriate way to address skill deficits.	1	2	3	4	5	6
3. This intervention should prove to be effective for increasing academic skills.	1	2	3	4	5	6
4. I would suggest the use of video self-modeling to other day treatment center therapists.	1	2	3	4	5	6
5. My client's skill deficits are problematic enough to warrant the use of video self-modeling.	1	2	3	4	5	6
6. Most DTC therapists would find video self-modeling to be a suitable intervention to increase skills.	1	2	3	4	5	6
7. Most DTC therapists would be willing to use video self-modeling within the DTC setting.	1	2	3	4	5	6
8. Video self-modeling would not result in negative side effects for my clients.	1	2	3	4	5	6
9. Video self-modeling would be an appropriate intervention for a variety of clients.	1	2	3	4	5	6
10. Video self-modeling is consistent with other interventions I have used in my therapy room.	1	2	3	4	5	6
11. This intervention was a fair way to address my client's skill deficits.	1	2	3	4	5	6
12. Video self-modeling is a reasonable intervention to use with my clients who struggle with skill deficits.	1	2	3	4	5	6
13. I like the procedures used in video self-modeling.	1	2	3	4	5	6
14. Video self-modeling is a good intervention to use with my client's skill deficits.	1	2	3	4	5	6

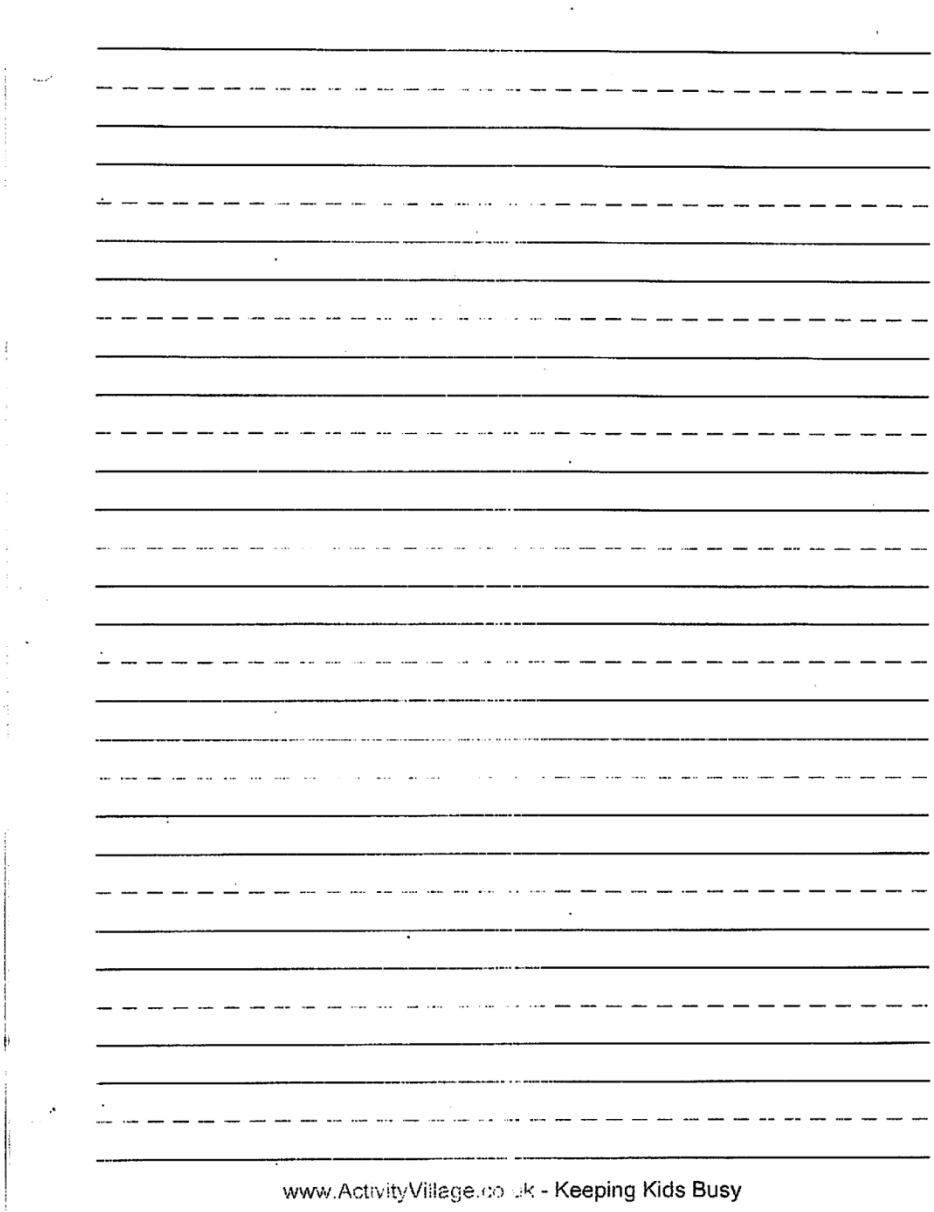
15. Overall, video self-modeling would be beneficial for my clients.	1	2	3	4	5	6
16. Video self-modeling would quickly improve my client's skill deficits.	1	2	3	4	5	6
17. Video self-modeling would improve clients' skills to the point that it would prepare them for a regular classroom.	1	2	3	4	5	6
18. Soon after using the video self-modeling intervention, a positive change in my client's academic skill level was observed.	1	2	3	4	5	6
19. My client's achievement would remain at an improved level even after discontinuing the use of the intervention.	1	2	3	4	5	6
20. Video self-modeling would not only improve client's achievement in handwriting, but may useful for teaching other skills, as well.	1	2	3	4	5	6
21. When comparing my client's achievement before and after use of the intervention, their handwriting skill level would be more closely aligned to typically developing children.	1	2	3	4	5	6
22. Video self-modeling should produce enough improvement in client's achievement so that handwriting is no longer a problem.	1	2	3	4	5	6
23. Other skill deficits related to the target skill also are likely to be improved by the intervention.	1	2	3	4	5	6

Appendix G: Children's Intervention Rating Profile

Please evaluate the use of video modeling by circling the number which best describes your agreement or disagreement with each statement. Please circle only one item for each statement.

	Strongly Disagree	**Disagree**	**Slightly Disagree**	**Slightly Agree**	**Agree**	**Strongly Agree**
1. The use of video self-modeling in the DTC was fair.	1	2	3	4	5	6
2. The use of video self-modeling in the DTC helped my handwriting.	1	2	3	4	5	6
3. The use of video self-modeling would help me learn how to write other words also.	1	2	3	4	5	6
4. It would be good for my therapist to use video self-modeling with other kids at the DTC.	1	2	3	4	5	6
5. I think that video self-modeling could help kids do better with other things.	1	2	3	4	5	6
6. Most kids would find video self-modeling to be a good way to get better at writing words.	1	2	3	4	5	6
7. I think that video self-modeling could one day help kids do better in school.	1	2	3	4	5	6

Appendix H : Handwriting Paper



Appendix I : Data Use Agreement

Initiative/Program/Intervention Oversight and Data Use Agreement

Maureen Childs, M.A.
River Oaks Tower Day Treatment Center Supervisor

6 June 2016

Geri Harris, is involved in the Evaluating the Efficacy of Video Self-Modeling for Remediating Dysgraphia in Children with autism spectrum disorders initiative which is being conducted under our organization's supervision within the scope of our standard operations. We understand that Geri Harris seeks to write about this initiative as part of a doctoral study for Walden University. To this end, we agree to share a de-identified dataset with the student for research purposes, as described below.

The Walden University Institutional Review Board (IRB) will be responsible for ensuring that the student's published study meets the university's ethical standards regarding confidentiality (outlined below). All other aspects of the implementation and evaluation of the initiative are the responsibility of the student, within her role as a volunteer.

The doctoral student will be given access to a Limited Data Set ("LDS") for use in the doctoral project according via the ethical standards outlined below.

This Data Use Agreement, effective as of June 2015, is entered into by and between Maureen Childs and River Oaks Day Treatment Center. The purpose of this Agreement is to provide Data Recipient with access to a Limited Data Set ("LDS") for use in research in accord with laws and regulations of the governing bodies associated with the Data Provider, Data Recipient, and Data Recipient's educational program. In the case of a discrepancy among laws, the agreement shall follow whichever law is more strict.

1. *Definitions. Unless otherwise specified in this Agreement, all capitalized terms used in this Agreement not otherwise defined have the meaning established for purposes of the "HIPAA Regulations" codified at Title 45 parts 160 through 164 of the United States Code of Federal Regulations, as amended from time to time.*

2. *Preparation of the LDS. Data Provider shall prepare and furnish to Data Recipient a LDS in accord with any applicable HIPAA or FERPA Regulations*

3. *Data Fields in the LDS. No direct identifiers such as names may be included in the Limited Data Set (LDS). In preparing the LDS, Data Provider or shall include the data fields specified as follows, which are the minimum necessary to accomplish the research: gender, age, baseline scores, intervention scores, maintenance scores, pretest scores, posttest scores, and*

Behavior Intervention Rating Profile scores, and Children's Intervention Rating Profile scores.

4. *Responsibilities of Data Recipient.* *Data Recipient agrees to:*

    a. *Use or disclose the LDS only as permitted by this Agreement or as required by law;*

    b. *Use appropriate safeguards to prevent use or disclosure of the LDS other than as permitted by this Agreement or required by law;*

    c. *Report to Data Provider any use or disclosure of the LDS of which it becomes aware that is not permitted by this Agreement or required by law;*

    d. *Require any of its subcontractors or agents that receive or have access to the LDS to agree to the same restrictions and conditions on the use and/or disclosure of the LDS that apply to Data Recipient under this Agreement; and*

    e. *Not use the information in the LDS to identify or contact the individuals who are data subjects.*

5. *Permitted Uses and Disclosures of the LDS.* *Data Recipient may use and/or disclose the LDS for its research activities only.*

6. *Term and Termination.*

    a. *Term.* *The term of this Agreement shall commence as of the Effective Date and shall continue for so long as Data Recipient retains the LDS, unless sooner terminated as set forth in this Agreement.*

    b. *Termination by Data Recipient.* *Data Recipient may terminate this agreement at any time by notifying the Data Provider and returning or destroying the LDS.*

    c. *Termination by Data Provider.* *Data Provider may terminate this agreement at any time by providing thirty (30) days prior written notice to Data Recipient.*

    d. *For Breach.* *Data Provider shall provide written notice to Data Recipient within ten (10) days of any determination that Data Recipient has breached a material term of this Agreement. Data Provider shall afford Data Recipient an opportunity to cure said alleged material breach upon mutually agreeable terms. Failure to agree on mutually agreeable terms for cure within thirty (30) days shall be grounds for the immediate termination of this Agreement by Data Provider.*

e. *Effect of Termination. Sections 1, 4, 5, 6(e) and 7 of this Agreement shall survive any termination of this Agreement under subsections c or d.*

7. *Miscellaneous.*

a. *Change in Law. The parties agree to negotiate in good faith to amend this Agreement to comport with changes in federal law that materially alter either or both parties' obligations under this Agreement. Provided however, that if the parties are unable to agree to mutually acceptable amendment(s) by the compliance date of the change in applicable law or regulations, either Party may terminate this Agreement as provided in section 6.*

b. *Construction of Terms. The terms of this Agreement shall be construed to give effect to applicable federal interpretative guidance regarding the HIPAA Regulations.*

c. *No Third Party Beneficiaries. Nothing in this Agreement shall confer upon any person other than the parties and their respective successors or assigns, any rights, remedies, obligations, or liabilities whatsoever.*

d. *Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument.*

e. *Headings. The headings and other captions in this Agreement are for convenience and reference only and shall not be used in interpreting, construing or enforcing any of the provisions of this Agreement.*

IN WITNESS WHEREOF, each of the undersigned has caused this Agreement to be duly executed in its name and on its behalf.

Partner Site (Student's Employer)	**Doctoral Student**
Signed:	**Signed: Geri Maria Harris**
Print Name:	Print Name: Geri Harris
Print Title:	Print Title: Student Researcher