1-1-2017

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Harris, G. M., Little, S. G., & Akin-Little, A. (2017). Video self-modelling as an intervention for remediating dysgraphia in children with autism spectrum disorders. *Australian Journal of Learning Difficulties, 22*, 153-170. https://doi.org/10.1080/19404158.2017.1397525

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 disorder (ASD). Video self-modelling (VSM) has been proven effective for children with ASD in the strengthening of social skills, verbalizations, and daily living skills. Because VSM has demonstrated success in the acquisition of many types of skills, it may prove similarly effective for remediating dysgraphia in children with ASD. Utilizing a single-subject design methodology with three 7-8 year old children diagnosed with ASD, this study examined VSM as a treatment for improving handwriting legibility and proficiency. All participants' legibility data showed a large effect sizes and high PNDs from baseline to treatment and maintenance phases, indicating that VSM is an effective treatment for improving and maintaining handwriting legibility in children with ASD. In addition, the social validity of the VSM treatment was established by the therapist and participants. Results are discussed in terms of applicability of VSM as an intervention with academic skills deficits in children with ASD.

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

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. 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-modelling (VSM) is a cognitive-behavioural 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. Therefore, the intent of this study was to examine VSM as a treatment for dysgraphia in primary school age children diagnosed with ASD.

Video Self-Modelling

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 behavioural treatment modality in which a video recording is created and edited to show the subject accurately performing a target behaviour. The video is then used as a teaching tool to help the subject actually acquire, or

increase proficiency in, that target behaviour (Buggey, 2007). By editing the video to show the subject independently performing the target behaviour, a perception of self-efficacy develops as the subject watches the video, increasing the likelihood that the behaviour will occur independently (Bellini & Akullian, 2007; Gelbar, Anderson, McCarthy, & Buggey, 2012).

Bellini and Akullian (2007) conducted a meta-analysis of video modelling (VM) and VSM, finding that both techniques were highly effective methods of helping children with ASD acquire a variety of skills. They indicated that results from reviewed studies indicate that VSM is a successful treatment for improving daily living skills (e.g., face and hand washing), social skills (e.g., conversational skills), and community skills (e.g., purchasing items). Gelbar et al. (2012) described how VSM has shown effectiveness across multiple behaviours, including the reduction of problematic behaviours and increase of socially desirable behaviours.

A less extensive literature exists examining VSM and an intervention for academic skills deficits however. Ayala and O'Connor (2013) used VSM for improving reading skills among typically developing first-grade students and found VSM to be effective for all students with 70% of participants maintaining their progress weeks later. 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.

Buggey (2007) discussed the value of VSM for the acquisition of a variety of practical skills in children with ASD, however, to date no research has explored the potential utility of VSM 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.

Theoretical Framework of VSM

Bandura's (1969) social learning theory offers a useful theoretical framework 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 similarity between the video model and the observer increases the probability that the behaviour 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.

When discussing VSM and Albert Bandura, a key term that arises is *perceived self-efficacy* (Hitchcock, Dowrick, & Prater, 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 behaviour (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 behavioural change. In 1997, he added that perceived self-efficacy could be directly influenced by self-modelling. When a person views a video successfully depicting him or herself modelling a behaviour that is slightly beyond his or her current level of performance, 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 behaviour (Bellini & Akullian, 2007; Gelbar et al., 2012). This sense of self-efficacy makes it probable that the person will produce the behaviour more frequently in the future (Bandura, 1997).

Autism Spectrum Disorder (ASD)

ASD is a neurodevelopmental disorder that begins in early childhood (APA, 2013). According to the US 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). ASD is so named because of the way that an individual's symptoms, often thought of as behavioural 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.

Handwriting and ASD

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 and colleagues (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 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 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 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. They also found that the quality of handwriting influenced perceptions about an applicant's level of motivation, laziness, and overall capability to complete a job. 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). Mayes and Calhoun (2007) found that approximately 50% of children with ASD have a comorbid diagnosis of dysgraphia. They further, 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 of the effectiveness of handwriting interventions. 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, they 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.

Summary

After exploring the available research on ASD, dysgraphia, and video self-modelling, a conclusion was reached that, to date, no research has attempted to examine VSM in treating dysgraphia in children with ASD. 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.

Method

Participants

Participants were drawn from a population of children with ASD from a day treatment facility specializing in the administration of ABA to children with developmental disabilities in Houston, Texas USA. Consistent with similar VSM research utilizing multiple baseline designs, the participants in this study included three children selected by facility staff. The following inclusion criteria were in place: (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.

The selected sample included two Caucasian boys and one African American girl between the ages of 7 and 8. All three participants had received prior diagnoses of ASD and were enrolled in full-time treatment at the facility. A facility 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. Staff were instructed to avoid any tasks associated with handwriting skills in order to preserve the integrity of the results as much as possible.

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. She exhibited marked deficits in verbal and nonverbal social communication. She had been enrolled in her educational programme 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 grade 2 classroom within the next

year.

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. He exhibited noticeable impairments in verbal and nonverbal social communication skills. He had been enrolled in his educational programme 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 grade 2 classroom within the next year.

Participant 3 was an 8 year, 1 month old Caucasian boy. He was diagnosed at age 5 with ASD Level 2, indicating that his severity level would require substantial support. He exhibited marked deficits in verbal and nonverbal social communication skills. He had been enrolled in his educational programme 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 grade 2 classroom within the next year.

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 clips.

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 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 provided with the WJ-III ACH. Scores were calculated utilizing a numerical value between 0 and 100 to reflect the participant's handwriting abilities. The numerical value on the legibility scale was calculated based upon factors such as slant, spacing, size, horizontal alignment, letter formation, and line quality.

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 were 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 authors report acceptable levels of reliability and validity.

Social Validity. The social validity of this study was measured using modified versions of the *Behaviour Intervention Rating Scale* and the *Children's Intervention Rating Profile*. The BIRS that was used for this study included 24 questions 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. Higher mean item scores are associated with greater acceptability of the intervention (Elliot & Treuting, 1991). Adaptations were made to this scale to emphasize the acceptability of this intervention within the specific context in which it was administered. The modified BIRS was completed by the behavioural therapists administering the VSM treatment.

The CIRP was used to determine the participants' perceived acceptability of the VSM treatment. The CIRP consists of seven self-report items related to the perceived fairness and expected effectiveness of a treatment (Carter, 2007). Items are rated on a Likert scale ranging 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, 2003). For comparison purposes, the CIRP responses were reversed-coded so that higher mean items signify greater acceptability. Items were read aloud to the participants and their answers recorded by therapists.

Proceduree

Baseline. Similar to previous VSM research, this study utilized a multiple baseline across participants design; therefore, baseline data were 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 can be drawn that changes are due to the treatment rather than to chance (Christ, 2007). Baseline data were 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. Treatment sessions occurred in the morning to promote attention and ensure consistency among participants.

During baseline, the therapist issued each instruction to the client to write the target word (i.e., "Write your name," "Write the word cat," "Write the word apple"). The client was given one piece of lined handwriting paper and a pencil prior to the instructions being issued. The responses made by the participant (i.e., all three words produced within a single session written on one piece of paper) were rated by two therapists using a numerical value between 1 and 100 based on the WJ-III ACH Handwriting Legibility Scale. The same two therapists were used across participants to ensure consistent scoring. Once the baseline was established, the treatment phase began.

Video Creation. After the participants were selected each took part in creating a video. The setting of the video was the same classroom where the intervention took place. Participants sat in a chair at a table located within the classroom. The video recorder 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 their faces but included their hands and the piece of lined paper placed directly in front of him or her on the table. A voice off camera issued instructions. The first instruction 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 instruction: "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 instruction 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-modelled 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.

Treatment Phase. The treatment phase 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, Participant 2’s sessions began after 8 days of baseline instruction, and Participant 3’s sessions began after 11 days of baseline instruction. The treatment phase lasted for 5 days for each participant.

During the treatment phase, the therapist played the self-modelled video at the beginning of each session. 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 writing paper depicted in the video. The therapist issued the same instructions as depicted in the video (i.e., “Write your name,” “write cat,” “write apple”). Participant’s responses were rated by

two therapists using a numerical value between 1 and 100 based on the WJ-III ACH legibility scale. The raters conferred to determine a final score.

Maintenance Phase. Four weeks after the conclusion of the treatment phrase staff resumed data collection. The participants were again issued the same instructions to write each of the targets words. During the maintenance sessions, participants did not view the self-modelled video prior to performing the target behaviour. Each participant completed 5 days of maintenance sessions post-treatment, which began 4 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 Scoring.

Results

The purpose of this study was to determine if VSM is an effective treatment for dysgraphia (i.e., legibility and proficiency of handwriting) in 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.

Legibility

Participant 1. As can be seen in Figure 1 Participant 1 had five baseline sessions, five treatment sessions, and five maintenance sessions. Her mean baseline level of performance was 9.8 (*SD* = .45) and relatively stable. During the treatment phase her mean legibility increased to 24.2 (*SD* = 1.24). A trend of increasing legibility was observed and response to the intervention was observed immediately upon implementation of the intervention. Participant 1's PND was

100% and baseline to intervention legibility was calculated to have an Effect Size of 11.6. Participant 1's mean maintenance level of performance was 24.2 (*SD* – 1.14). Baseline to maintenance PND was 100% with a baseline to maintenance Effect Size of 11.6. Results for Participant 1 indicate that VSM was an effective intervention and the results were maintained over time once the intervention was removed.

Insert Figure 1 About Here

Participant 2. As can be seen in Figure 1 Participant 2 had eight baseline sessions, five treatment sessions, and five maintenance sessions. Participant 2's mean baseline level of performance was 15.62 (*SD* = .92). The baseline was relatively stable with a range of 14 to 17. During treatment, Participant 2's mean legibility score increased to 27.2 (*SD* = .72). A modest increasing trendy was observed and Participant 2 began to respond to the intervention immediately upon implementation of the intervention. His PND from baseline to intervention was 100% with an effect size of 12.47. Participant 2's mean during the maintenance phase was 24.6 (*SD* = 1.08). Baseline to maintenance PND was 100% with a baseline to maintenance Effect Size of 12.47. Results for Participant 2 indicate that VSM was an effective intervention and the results were maintained over time once the intervention was removed.

Participant 3. As can be seen in Figure 1, Participant 3 had 11 baseline sessions, five treatment sessions, and five maintenance sessions. Participant 3's mean baseline level of performance was 5.54 (*SD* = 1.04). The baseline was relatively stable with a range of 4 to 8. During treatment, Participant 3's mean legibility score increased to 16.0 (*SD* = 2.55). A modest

increasing trendy was observed and Participant 3 began to respond to the intervention immediately upon implementation of the intervention. His PND from baseline to intervention was 100% with an effect size of 10.06. Participant 3's mean during the maintenance phase was 19.2 (*SD* = 1.30). Baseline to maintenance PND was 100% with a baseline to maintenance Effect Size of 10.06. Results for Participant 3 indicate that VSM was an effective intervention and the results were maintained over time and stabilized once the intervention was removed.

Proficiency

Changes in handwriting proficiency were measured with pretest/ posttest data gathered from the *HSPQ* and the *HSPQ-C*.

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. 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 she was verbalizing less pain and fatigue while writing. The therapist noted that others could now more easily read her writing.

Participant 2. Participant 2's pretest self-report score on the HSPQ-C was 31 out of 40. His posttest score 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. The 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 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.

Social Validity

The *BIRS* and *CIRP* examined the acceptability of the treatment for both the therapist and the participants. The mean score out of all 23 items on the *BIRS* was used to examine the acceptability of the treatment for the therapist who administered the treatment. Mean scores at or above 4 represent acceptability of the treatment (Cihak, Alberto, & Fredrick, 2007). The therapist gave a mean rating of 4.39 indicating she found the VSM intervention to be acceptable.

The modified *CIRP* was administered to all participants as a measure of their acceptability of the VSM treatment. Mean scores at or above 4 are considered acceptable (Cihak et al., 2007). 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. Participant 1 had a mean score of 4.49, Participant 2 mean was 5.0, Participant 3 had a mean score of 4.14.

Treatment Fidelity

Bellini et al. (2007) recommend the use of specific charts to 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 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 needed one verbal prompt during session 1 and a second verbal prompt during session 4. Participant 3 needed three verbal prompts during the first session, one during Session 2, three during Session 3, and one during Session 4.

Discussion

The primary objective of this study was to determine if video self-modelling (VSM) could improve the handwriting legibility and proficiency of three child participants with autism spectrum disorder (ASD). Changes in legibility between baseline, intervention, and maintenance phases were measured by daily probes assessing the target skill of writing three words taken from the *Woodcock Johnsons Tests of Achievement – 3rd Edition* (*WJ-III ACH*). 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). Social validity data were also collected,

Results indicated that all three participants exhibited increasing levels of handwriting legibility following the implementation of VSM treatment with these increases being maintained

4 weeks posttreatment. All began to respond to treatment almost immediately with a trend of increasing legibility being observed from baseline to intervention, moving from low to moderate levels, with these improvements being maintained during the post treatment phase. 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 et al., 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. The present research 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. However, due to the multiple baseline design and the stability of each participant's score during baseline, it is unlikely that practice effects alone would be sufficient to account for this level of improvement. Instead, it is believed that once participants began to experience improvement in legibility, increased self-efficacy and a better understand the requirements of the task, helped to motivate 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.

Proficiency was demonstrated as improving across all participants, as evidenced by a decrease in scores of problem behaviour 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 of a significant magnitude. 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 behaviours (Beyer, McGrath, & Berde, 1990); adult therapists may prove a better source of information. However, 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. The therapists, who are trained to be more objective in their observation of the children's behaviour, 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. We believe the results represent satisfactory evidence in support of an increase in handwriting proficiency for these children and provide support for previous research which has also shown an increase in the skills of children with ASD following VSM treatment (Boudreau & Harvey, 2013; Cihak et al., 2010; Lasater & Brady, 1995).

When examining the overall level of acceptability of VSM treatment it was found that both therapists and participants agreed that VSM is an acceptable treatment for handwriting with this population. 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.

Conclusions

It seems reasonable to conclude that VSM is a well-received and effective treatment for remediating dysgraphia in children with ASD. VSM demonstrated a significant improvement in legibility ratings across all three participants. Because handwriting difficulties are so common among children with ASD (Kushki et al., 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.

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.

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 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, they are very limited in scope. 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 day treatment center 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.

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 sought to examine if VSM would be an efficacious and socially acceptable treatment for remediating dysgraphia in a sample of children with ASD.

The overall purpose of this research was to examine the effectiveness of VSM on the legibility and proficiency of participants who had previously shown difficulty with handwriting. Results 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. A secondary purpose of this research project was to address the social validity surrounding the use of VSM. All three participants, as well as the therapist participant, reported the treatment as socially valid.

This research 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 across the globe, 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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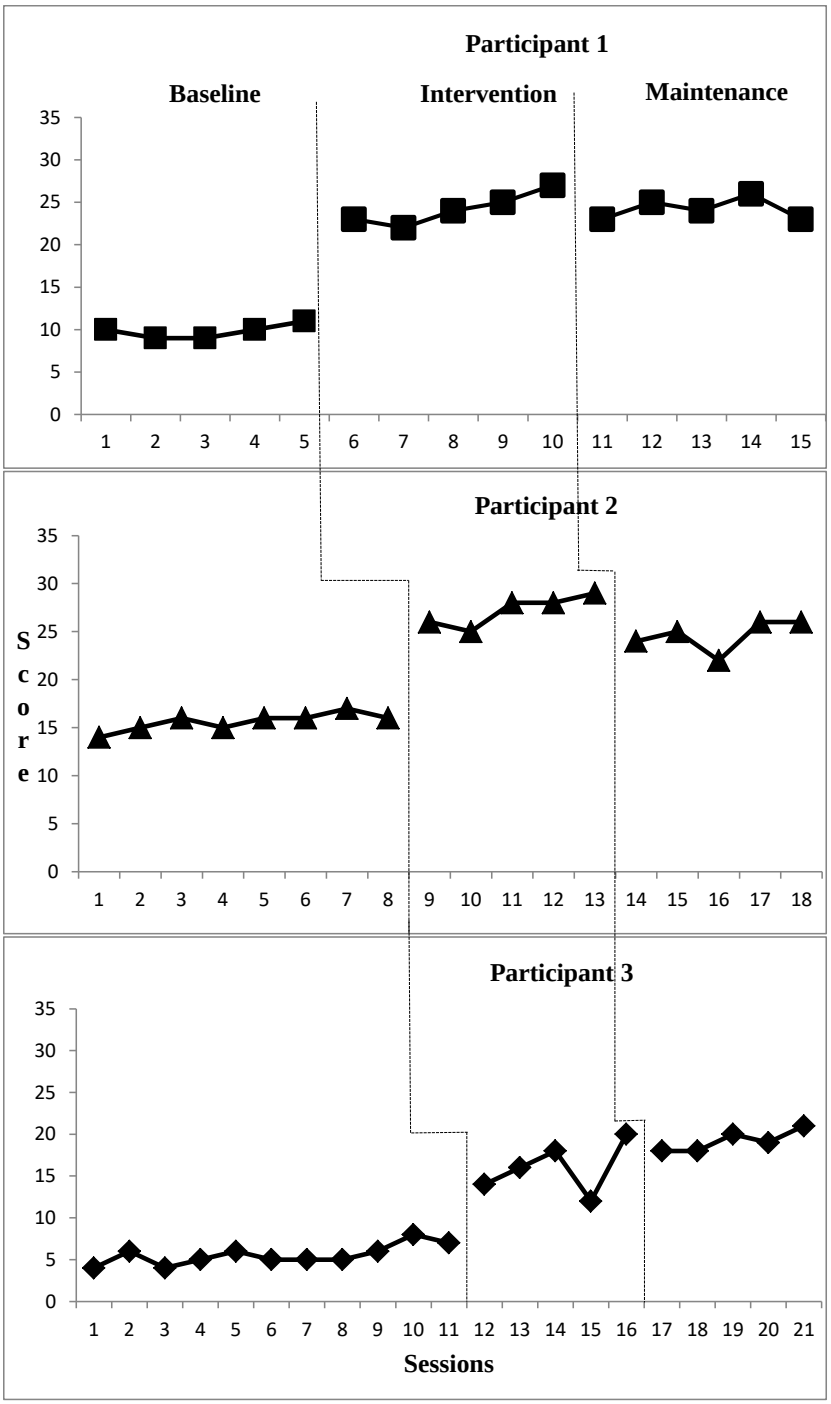

Figure 1. Legibility scores (WJ-III Handwriting Legibility Scale) across phases