The Impact of Video Self-Modeling on Reading Performance

Among Struggling Readers: A Meta-Analysis

by

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Abstract

Students with specific learning disorder in reading may require intervention to improve reading performance and prevent a number of undesirable outcomes such as lower income, higher rates of high school dropout, and reduced working hours. Video self-modeling (VSM) is one such reading intervention. It involves videotaping a child reading and then editing out his or her errors, before having the child view him/herself reading “effortlessly.” VSM is based on Vygotsky’s theory of the zone of proximal development and Bandura’s work on self-efficacy and peer modeling. Early work on the effectiveness of VSM as a reading intervention has shown promise; however, a meta-analysis is needed to synthesize the current literature and to determine which variables contribute to an effective implementation of VSM. This meta-analysis performed an extensive literature review and found 29 data points from eleven papers that met the selection criteria. These data points were analyzed to determine the effectiveness of VSM as an intervention for improving the reading performance of struggling readers. Moderators used in this study were: grade of participant, number of sessions, and whether VSM was applied alone or in conjunction with other interventions. Analysis showed that VSM was an effective reading intervention that resulted in improved reading performance by 0.99 standard deviations. VSM was found to be most effective when implemented with students at earlier grades, and when the number of sessions was greatest. In addition, VSM was most effective when applied in conjunction with other interventions. Overall, this meta-analysis shows that VSM is a promising reading intervention for students with, or at risk for, specific learning disorder in reading, and should be considered by teachers looking for an effective reading intervention.
Keywords: dyslexia, efficacy beliefs, intervention, specific learning disorder, video feed-forward, zone of proximal development
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# TABLE OF CONTENTS

Abstract ........................................................................................................................................... iii

Acknowledgements ............................................................................................................................. v

Table of Contents .............................................................................................................................. vi

List of Tables ...................................................................................................................................... vii

List of Figures .................................................................................................................................... ix

Chapter 1- Introduction ..................................................................................................................... 1

  Characterization of Specific Learning Disorder ........................................................................... 1

  Prevalence and Implications of Specific Learning Disorder ....................................................... 1

  Subtypes of Specific Learning Disorder in Reading ................................................................. 2

  Effectiveness of Reading Interventions ..................................................................................... 3

  Video Self-Modeling as a Reading Intervention ......................................................................... 4

  Justification for Studying VSM ................................................................................................. 4

  Statement of Problem and Purpose ....................................................................................... 5

  Research Question ................................................................................................................... 5

  Researcher Context .................................................................................................................. 6

  Overview of Study ................................................................................................................... 7

Chapter 2- Literature Review ........................................................................................................... 8

  Overview of Chapter ................................................................................................................ 8

  Zone of Proximal Development and Scaffolding .................................................................. 8

  Efficacy Beliefs ......................................................................................................................... 10

  Video Self-Modeling Links to the Zone of Proximal Development and Scaffolding .......... 10
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Research on VSM</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Conclusion</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Chapter 3- Methods</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Overview of Chapter</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Meta-analysis</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Data Sources</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Study Selection Criteria</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Data Collection</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Effect Size Calculation</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Limitations of Meta-Analyses</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Reliability, Validity, and Generalizability</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>Chapter 4- Finding and Results</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>Results of Electronic Database Search</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>Meta-analysis Modeling Results</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>Moderators</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>Isolating the Effects of VSM</td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>Chapter 5- Discussion</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>Summary: Effectiveness of VSM for Students with, or at risk for, SLD in Reading</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>VSM Links to the Zone of Proximal Development and Efficacy Beliefs</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Effect of Moderators</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Limitations and Suggestions for Future Research</td>
<td></td>
<td>31</td>
</tr>
<tr>
<td>Conclusion</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>References</td>
<td></td>
<td>33</td>
</tr>
</tbody>
</table>
List of Tables

Table 1. Hypothesized effects of moderators on reading performance as a function of VSM.....17
List of Figures

Figure 1. PRISMA diagram showing identified studies that address VSM as an intervention for reading performance among struggling readers. .................................................................16

Figure 2: Forest plot of weighted effect sizes (standardized mean difference) with 95% confidence intervals for studies that report data on the impact of VSM on reading. ............23

Figure 3: Funnel plot of random effects meta-analysis model for the effects of VSM on reading........................................................................................................................................24

Figure 4: Scatterplot of number of sessions of VSM implementation on overall mean effect size from a random effects meta-analysis model. .................................................................25

Figure 5: Scatterplot of the effect of student grade on overall mean effect size from a random effects meta-analysis model. .................................................................26

Figure 6: Confidence interval plot of the effect sizes of VSM alone versus VSM applied alongside one or more other interventions. .................................................................28
Chapter 1

Introduction

Characterization of Specific Learning Disorder

According to the American Psychiatric Association (2013), specific learning disorder (SLD) is characterized by persistent difficulty in acquiring and applying key academic skills. It is a neurodevelopmental disorder that occurs in school-aged children, and can impact important academic areas, including mathematics (such as reasoning and calculation), writing (including spelling and written expression), and reading (including comprehension, decoding, and fluency). It negatively affects achievement in key academic area(s), resulting in below average performance compared to peers. This, in turn, can result in avoidance of the academic area(s) (Sideridis, 2003). Severity of SLD varies depending on the child; when a child is diagnosed with SLD, it is indicated if the SLD is mild, moderate, or severe (American Psychiatric Association, 2013).

It is important to note that SLD is not to be confused with intellectual disability, as they are very different diagnoses. With SLD, a child exhibits underachievement in a given academic area relative to his or her general intellectual ability. In other words, “specific learning disorder affects learning in individuals who otherwise demonstrate normal levels of intellectual functioning….The phrase ‘unexpected academic underachievement’ is often cited as the defining characteristic of specific learning disorder” (American Psychiatric Association, 2013, p. 69).

Prevalence and Implications of Specific Learning Disorder

SLD occurs in 5-15% of school-aged children (American Psychiatric Association, 2013). According to Statistics Canada (2014), having a learning disorder is correlated with a number of undesirable outcomes for respondents including reduced income, fewer working hours, lower
levels of education, and a higher unemployment rate, relative to those without disorders. Specifically, respondents who reported having a learning disorder earned $12,200 per year (median) compared to those without a disorder who earned $31,200 per year (median). They also worked fewer hours – an average of 28 hours per week instead of the average of 37 hours per week that those without a disorder worked (Statistics Canada, 2014).

In a two-year longitudinal study, Rojewski, Lee, and Gregg (2014), found that recent high school graduates with learning disorders exhibited higher unemployment rates and reduced working hours compared to those without learning disorders. According to Statistics Canada (2014), those with learning disorders were also much more likely to drop out of high school, with a rate of 33%; this is a stark difference when considering that only 13.1% of the general population did not complete high school. Employment rates for those with learning disorders were also significantly lower than for those without disorders: only 28.8% of adults with a learning disorder were employed, compared to 73.6% of adults without a disorder (Statistics Canada, 2014). Of particular note, this survey by Statistics Canada (2014) did not include Canadians in judicial or mental health institutions, suggesting that these numbers are conservative estimates of the actual impacts of learning disorders. Hyun, Hahn, and McConnell (2013) agree that “there is unequivocal evidence that persons with learning disorders are over-represented in the prison population” (p. 308). Due to the negative outcomes experienced by adults with learning disorders, it is important to intervene early so that these individuals have every available opportunity to succeed.

Subtypes of Specific Learning Disorder in Reading

SLD in reading can have considerable impacts on a child’s education and future, as the ability to read is an integral skill in many school subjects (American Psychiatric Association,
SLD in reading is often referred to as dyslexia. It is one of the most commonly diagnosed SLDs (American Psychiatric Association, 2013). It is defined as “a pattern of learning difficulties characterized by problems with accurate or fluent word recognition, poor decoding, and poor spelling abilities” (American Psychiatric Association, 2013, p. 67). Mather, Goldstein, and Eklund (2015) differentiate between two types of dyslexia: phonological dyslexia and orthographic dyslexia. With phonological dyslexia, the individual has trouble with phonological processing, which involves the ability to manipulate and integrate sounds efficiently (Newby, Recht, & Caldwell, 1993). This has a major impact on the individual’s ability to encode and decode words (Mather et al., 2015). In contrast, individuals with orthographic dyslexia have difficulty with “sight word retention, reading and spelling, irregular letter strings, and rapid word identification” (Mather et al., 2015, p. 234). Both types of dyslexia can have a large impact on an individual’s ability to learn and his or her educational achievement.

**Effectiveness of Reading Interventions**

Considering the prevalence of SLD and its impacts, it is critical that we find ways to support students with SLD in the classroom so that they have the skills and abilities to reach their full potential. Reading interventions – activities that provide struggling readers with strategies to help promote success in reading – offer opportunities for students with SLD to maximize success in reading. Gersten, Newman-Gonchar, Haymond, and Dimino (2017) reviewed 20 studies on reading interventions and found that reading interventions had positive impacts on reading performance in children who struggled to read. Specifically, the vast majority of these interventions had positive impacts in at least one of the following areas of reading performance: reading comprehension, reading fluency, vocabulary, and word and pseudoword reading (Gersten et al., 2017). Similarly, Elbaum, Vaughn, Hughes, and Moody (2000) conducted a
meta-analysis of 29 studies on one-on-one reading interventions and found that they were highly effective when the interventions were delivered by a trained adult. Thus, it is important that teachers utilize reading interventions that improve reading skills to help students to be successful in school and beyond. There are many reading interventions available that vary in their cost, effectiveness, and target area of reading. One promising intervention that has received relatively little research to date is video self-modeling.

**Video Self-Modeling as a Reading Intervention**

Ayala and O’Connor (2013) define video self-modeling (VSM) as the process of video-recording a student as he or she performs a target behaviour while an educator uses prompts and coaching to promote success. The educator then edits the video so that only the target behaviour remains and all prompting and coaching is removed. The student later views this edited video a number of times to see himself or herself successfully performing the target behaviour. VSM is based on Lev Vygotsky’s theory of the zone of proximal development (1978), and Albert Bandura’s work on video modeling (Bandura, 1986; 2001; as cited in Ayala & O’Connor, 2013).

**Justification for Studying VSM**

An effective intervention is one that consistently has high rates of success (i.e. the treatment group outperforms the comparison group, and the difference between the groups is statistically significant (Gersten et al., 2017)), and will work for the student(s) that the teacher has in mind. However, determining which interventions are most effective for particular students is not a simple task. There are countless interventions available for teachers to choose from to support struggling readers, and many teachers are overwhelmed by the number of options. It takes considerable time to sift through the inordinate number of studies to find the
right intervention for a particular student or group of students. Many teachers simply do not have the time or resources to do so.

VSM has been used in a number of educational contexts, including increasing social engagement among children with autism (Bellini, Gardner, Hudock, & Kashima-Ellingson, 2016); increasing on-task behaviour during math class for students with autism (Schatz, Peterson, & Bellini, 2016); and improving oral reading fluency in ELL students (Ortiz, Burlingame, Onuegbulem, Yoshikawa, & Rojas, 2012), to name a few. Some studies point to the effectiveness of VSM for helping struggling readers learn to decode words fluently (Ayala & O’Connor, 2013), but further research is needed in this area.

Statement of Problem and Purpose

A number of studies have explored the impact of VSM on reading performance (e.g. Bray, Kehle, Spackman, & Hintze, 1998; Dowrick, Kim-Rupnow, & Power, 2006; Ayala & O’Connor, 2013). However, these studies utilized different methodologies, different populations, and often employed a number of interventions simultaneously or in conjunction with one another. As such, results demonstrate varying degrees of effectiveness and may be attributable to more than one factor or intervention. This is problematic, in that it is difficult to draw reliable and generalizable conclusions regarding VSM and its utility for improving reading performance. Consequently, the overall effectiveness of VSM as a reading intervention is unclear and would benefit from a meta-analysis that analyzes VSM studies under a common statistical framework. The purpose of this study is to synthesize results from existing research in order to determine the overall effectiveness of VSM on reading performance among struggling readers.

Research Question
The research question addressed in this meta-analysis is “How effective is VSM for improving the reading performance of students with, or at risk for, specific learning disorder in reading?” Students were identified by researchers as being “at risk” when they were considerably behind their peers in reading. This at-risk group was included because many students are not formally designated as having SLD until much later in their education.

If VSM proves to be an effective intervention for struggling readers, it has the potential for widespread use within the educational system. Classroom and Learning Support Teachers may choose to employ this intervention, subsequently benefitting the students that need the most support in terms of reading. Students with, or at risk for, SLD in reading have the potential to benefit the most from this meta-analysis. If it is effective, teachers can use it with confidence to support their students in their journey toward becoming successful readers.

**Researcher Context**

My experience as an educator, both in the classroom and in the field of inclusive education, has given me an appreciation of the great need for improving understanding of effective reading interventions for struggling readers. In my experience, there are many students needing support and it can be difficult to determine the most effective support for a particular student or group of students. Part of the problem is that we need to improve understanding and access to effective reading interventions among teachers. There is a plethora of interventions available, with many newer interventions showing promise. However, there are many barriers to implementing reading interventions widely, such as lack of specific training and cost of materials (see Denton, Vaughn, & Fletcher, 2003). In addition, as a full-time teacher, I find it very difficult to determine where to allocate my limited time to learning new interventions for struggling readers. One such intervention that interests me is VSM, as it has shown some
promise in a number of studies (e.g. Ayala & O’Connor, 2013). As such, I chose to do a meta-analysis on VSM to simplify the research process for teachers, which will allow them to increase the objectivity of their conclusions regarding the potential impact of VSM for their struggling readers.

**Overview of Study**

In this study, I conducted a meta-analysis that aimed to determine the effectiveness of VSM as an intervention for improving reading performance among students who have, or are at risk for, SLD in reading. Relevant papers were identified through specific search terms in electronic databases, and through literature reviews on VSM and reading performance. The data generated from this study was statistically analyzed to determine the effectiveness of VSM as an intervention for improving reading performance among struggling readers. Moderators were used to account for extraneous variables and to improve internal validity.

In Chapter 2, literature on the zone of proximal development and efficacy beliefs was reviewed and links between these and VSM were outlined. Chapter 2 concluded with a review of the current literature on VSM. In Chapter 3, the methodology used to analyze the relevant studies on VSM and struggling readers was outlined and the findings and results were discussed in Chapter 4. Chapter 5 summarized the results of this study with respect to the zone of proximal development and efficacy beliefs, before concluding with a discussion of future directions for research on VSM.
Chapter 2

Literature Review

Overview of Chapter

In this chapter, the theoretical underpinnings of video self-modeling (VSM) through the lens of Vygotsky’s (1978) theory of the zone of proximal development and Bandura’s (1986; 2001) work on self-efficacy and peer-modeling are outlined. Current literature with a focus on the impact of VSM on reading is reviewed. Finally, the chapter concludes with a synthesis of knowledge gaps, areas of further research, and how this study contributes to the literature on VSM.

Zone of Proximal Development and Scaffolding

Video self-modeling has its roots in Lev Vygotsky’s theory of the zone of proximal development (Vygotsky, 1978) and Albert Bandura’s work on peer modeling (1986; 2001; as cited in Ayala & O’Connor, 2013). Vygotsky states that “learning and development are interrelated from the child’s very first day of life” (Vygotsky, 1978, p. 32) and that “children can imitate a variety of actions that go well beyond the limits of their own capabilities” (Vygotsky, 1978, p. 34). As such, Vygotsky (1978) asserts that it is important to differentiate between what a child can accomplish independently (actual development) and what he or she can accomplish with the help of a more proficient peer or an adult. He terms this discrepancy the “zone of proximal development” and defines it as “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (Vygotsky, 1978, p. 33). In other words, actual development is the sum of development to date, while the zone of proximal development predicts what a child is capable of with help.
(Vygotsky, 1978). It is important to note that “the extent to which the learning process brings a child benefit over the course of working together is tied to how much the child moves within the [zone of proximal development] with appropriate help from the adult” (Zaretskii, 2009, p. 87). Therefore, work that is too easy or too hard will not benefit the child to the same extent that appropriately challenging work will.

The zone of proximal development is a necessary precursor to learning – once a child has worked within his or her zone of proximal development, the developmental processes required of the activity become internalized and the child is able to perform the same task independently (Vygotsky, 1978). In other words, the learning process precedes the developmental process and requires work within the zone of proximal development (Vygotsky, 1978). The zone of proximal development is now widely recognized by educational and developmental psychologists (Chaiklin, 2003).

Wood, Bruner, and Ross (1976) state that much of a developing child’s ability to solve problems early on is guided by his or her interactions with a tutor. The authors place considerable importance on these tutorial interactions, identifying them as critical to early development. Further, they use the term “scaffolding” to describe the process of working within the zone of proximal development; “this scaffolding consists essentially of the adult ‘controlling’ those elements of the task that are initially beyond the learner’s capacity, thus permitting him to concentrate upon and complete only those elements that are within his range of competence” (Wood et al., 1976, p. 90). Scaffolding is therefore a necessary component of moving forward within the zone of proximal development.

The development of early literacy is critically linked to both the zone of proximal development and scaffolding (Bodrova & Leong, 1998; Englert, Rozendal, & Mariage, 1994;
Henderson, Many, Wellborn, & Ward, 2002; Neumann, Hood, & Neumann, 2009). Learners must develop a number of critical, interrelated skills to acquire the ability to decode text, develop fluency and build comprehension (Mather et al., 2015). These skills can be most effectively developed by working within the zone of proximal development.

**Efficacy Beliefs**

Closely linked to the theory of the zone of proximal development are efficacy beliefs (Bandura, 2001). Perceived self-efficacy is defined as a person’s beliefs that he or she can accomplish tasks required to achieve specific levels of performance (Bandura, 1986). Bandura asserts that “it is partly on the basis of efficacy beliefs that people choose which challenges to undertake, how much effort to expend in the endeavor, [and] how long to persevere in the face of obstacles and failures” (Bandura, 2001, p. 10). Therefore, a child’s efficacy beliefs about reading abilities play an important role in developing reading skills; increased confidence can increase performance (Quirk, Schwanenflugel, & Webb, 2009). Furthermore, according to Bandura (2001), “the likelihood that people will act on the outcomes they expect prospective performances to produce depends on their beliefs about whether or not they can produce those performances” (p. 10).

**Video Self-Modeling Links to the Zone of Proximal Development and Scaffolding**

Video self-modeling is “a cognitive-behavioural technique that enables participants to see themselves performing a target behaviour…that is outside their usual repertoire” (Montgomerie, Little, & Akin-Little, 2014, p. 18). With VSM, students engage in reading from a grade-appropriate text with the support of an adult, and this reading is videotaped. The edited version of the video shows the student reading fluently and is viewed a set number of times per week by the respective student. The zone of proximal development can therefore play a pivotal role in
VSM. For example, when a child sees himself or herself successfully completing a task within his or her zone of proximal development, he or she may experience feelings of high self-efficacy and be more likely to persevere on such tasks.

VSM was first introduced to the field of child psychology by Creer and Miklich (1970) as a means of behaviour modification. Creer and Miklich (1970) used video self-modeling to modify maladaptive social behaviours in a ten-year-old boy. They found that implementation of VSM resulted in an abrupt shift to appropriate behaviours. Following this early work of Creer and Miklich (1970), VSM is now gaining use in the field of education, particularly in interventions for students with autism (Bellini et al., 2016; Schatz et al., 2016), ELL students (Ortiz et al., 2012), and students with learning disorders (Ayala & O’Connor, 2013).

**Current Research on VSM**

Research done within approximately the last two decades has looked at VSM and its impacts on reading performance and has shown that it has considerable potential as an intervention for improving reading performance, especially with respect to students with, or at risk for, SLD in reading. Bray et al. (1998) were one of the first groups of researchers to explore the effects of VSM on reading. Five children in Grade 3 were included in their study. Two interventions per week were performed over four weeks, and results showed increases in reading fluency across all students. Similarly, Hitchcock, Prater, and Dowrick (2004) conducted a study using tutoring and VSM as an intervention for four students in Grade 1 who had reading difficulties. The intervention took place on a daily basis over a period of four weeks. They found that reading fluency and comprehension both increased as a result of their intervention. Likewise, Dowrick et al. (2006) conducted a multiple baseline intervention in which a tutoring program was followed by a program involving tutoring and VSM simultaneously. Results
showed significant improvement for reading fluency for all students as a result of the interventions. Notably, improvement was greatest during the tutoring-VSM component for 9 out of 10 of the students. Similarly, Ayala and O’Connor (2013) used VSM to improve sight word recognition and decoding skills of ten Grade 1 students who were struggling with their reading. Results showed increases in sight word recognition and decoding skills for all participants. In addition, Montgomerie et al. (2014) conducted a multiple-baseline-across-subjects study that looked at the impact of VSM on oral reading fluency. Results indicated that fluency improved for all students, but results were only significant for three out of four of the students. Finally, Robson, Blampied, and Walker (2015) conducted a study that explored the impact of VSM on reading fluency and comprehension. They found that students exhibited improvement in reading accuracy, comprehension, and fluency.

While this preliminary research suggests that VSM is an effective intervention for improving reading performance, there are a number of limitations in these studies that indicate that further research is needed in this area. One weakness of previous research was small sample sizes. For example, Montgomerie et al. (2014) had a sample size of only four students, limiting conclusions that could be drawn from this study, since with only four students, the study is more likely to be biased by a single outlier. A second weakness was that, in many studies, multiple interventions were being conducted simultaneously. One example of this was Hitchcock et al.’s (2004) study where both a tutoring program and VSM were used simultaneously, preventing the ability to clearly attribute gains to either the tutoring or VSM intervention. A third weakness of previous studies was the variable number of sessions among studies. For example, Robson et al. (2015) had six sessions over two weeks, while Ayala and O’Connor (2013) had a minimum of
four sessions per week, over a period of 12 weeks. This variability among studies means that determining the most important factors in a successful application of VSM is difficult.

**Conclusion**

The field of video self-modeling shows promise as an intervention for struggling readers, as it incorporates the zone of proximal development and helps to build self-efficacy. However, there are a number of research gaps that remain before this approach can be widely applied with confidence. Namely, studies need to account for confounding variables by limiting the number of interventions applied simultaneously, increasing sample sizes, and clarifying the effect of the number of sessions.

In my study, I conducted a meta-analysis that sought to determine the effectiveness of VSM on improving reading performance. I determined the overall effectiveness of VSM as an intervention for struggling readers by systematically reviewing studies, placing studies in a common statistical framework, and considering confounding variables. This research sought to address some of the shortcomings of previous studies and build upon the current knowledge base of VSM and its impacts on reading performance.
Chapter 3

Methods

Overview of Chapter

In this chapter, the methodology used to identify, filter, and collect data from studies is outlined. A discussion of methods for analyzing the data collected follows.

Meta-analysis

A meta-analysis is a quantitative review and synthesis of studies published in a specific area (Koricheva, Gurevitch, & Mengersen, 2013). Studies are identified through standardized, repeatable search terms, and are reviewed to determine whether they meet inclusion criteria before data is collected from these studies and analyzed under a common framework (Koricheva et al., 2013). I chose to do a meta-analysis because, while there have been a number of studies and systematic reviews on the effectiveness of VSM on reading, there is still uncertainty regarding the overall effectiveness of this intervention. The studies to date have employed different methodologies on different populations, and have found differential effectiveness. Meta-analyses are recognized as an effective way to synthesize disparate literature in many fields (Gurevitch, Koricheva, Nakagawa, & Stewart, 2018), and are often used in the field of education to compare the collective effectiveness of different interventions (Ehri et al. 2001; Ahn, Ames, & Myers, 2012). Thus, a meta-analysis of the VSM research provides a way to determine which studies have found the largest effects, and may guide future research and determine the best way to apply VSM to support at-risk students.

Data Sources

In order to identify literature that examined the role of VSM on reading performance, electronic databases (ERIC, Web of Science, and PsycINFO) were systematically searched using
the following search terms: “video self-modeling” and “reading,” as well as “video feedforward” and “reading.” These search terms were determined based on an extensive review of the VSM literature. References of previous systematic reviews (i.e. Prater, Carter, Hitchcock, & Dowrick, 2012; and Alsalamah, 2017) were also reviewed to identify any studies not captured by these search terms (see Figure 1). It is important to note that, while the research question in this study is very similar to the one posed by Alsalamah (2017), the methodology of the two studies differ considerably; a systematic review synthesizes results qualitatively, while a meta-analysis synthesizes results quantitatively.

**Study Selection Criteria**

From the studies identified with the search terms above, titles and abstracts were read to determine relevance, and studies not related to video self-modeling and reading were eliminated (Figure 1). Inclusion criteria used in this meta-analysis were: (1) that the study must involve primary quantitative research; (2) that the study must be designed to determine the effect of VSM on at least one measurable aspect of reading; (3) that the population studied must be designated as having, or being at risk for, an SLD in reading; (4) that there must be pre- and post-intervention data available; (5) that a standardized assessment must be used; and (6) that scores for individuals or group means and standard deviations must be reported or be possible to calculate from available data.
Figure 1: PRISMA diagram showing identified studies that address VSM as an intervention for reading performance among struggling readers.

**Data Collection**

For each study that met the selection and inclusion criteria, scores for each student were extracted before and after the VSM intervention. If scores were not reported on an individual student basis, group means and standard deviations were extracted before and after the VSM intervention. From each study, sample size, number of sessions, the nature of the study (i.e. if VSM was applied as the sole intervention or in conjunction with one or more other interventions), and grade of participants were recorded. These variables were used as moderators in the analysis (see Table 1). Student means were averaged in each study when
presented individually, since student-level data was not always available. Data was extracted from the text or figures using the data extraction program, Engauge Digitizer (Mitchell et al., 2018). If studies included more than one dependent variable (for example, reading accuracy and reading fluency), data was included for each dependent variable in this meta-analysis, although study was included as a random effect in the models to account for pseudoreplication (i.e. if the same group of students is taking different tests, you would expect their results to be more similar than if different groups of students were taking different tests).

Table 1: Hypothesized effects of moderators on reading performance as a function of VSM

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<th>Moderator</th>
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<tr>
<td>Number of sessions</td>
<td>Greater number of sessions is positively correlated with effect size</td>
</tr>
<tr>
<td>Nature of study</td>
<td>More interventions are positively correlated with effect size</td>
</tr>
<tr>
<td>Grade of participant</td>
<td>Age of participants is negatively correlated with effect size</td>
</tr>
</tbody>
</table>

Effect Size Calculation

In order to determine whether VSM significantly improves reading performance and how moderators may influence this effect, standardized mean difference was computed via Hedges’ $g$. Hedges’ $g$ allowed for the comparison of studies with different designs, sample sizes and standard deviations (Koricheva et al., 2013). According to Koricheva et al. (2013), Hedges’ $g$ is calculated by

$$g = \frac{\bar{Y}_1 - \bar{Y}_2}{\sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}}}$$
where $\bar{Y}_1$ is the mean post-intervention score and $\bar{Y}_2$ is the mean pre-intervention score for VSM. $n_1$ corresponds to the number of participants and $s_1$ is the standard deviation. $J$ corrects for small sample sizes and is calculated by

$$J = 1 - \frac{3}{4(n_1 + n_2 - 2) - 1}$$

Koricheva et al. (2013) further state that Hedges’ $g$’s variance is calculated by

$$v_g = \frac{n_1 + n_2}{n_1 n_2} + \frac{g^2}{2(n_1 + n_2)}$$

A linear mixed-effects model was used to determine overall effect size, the influence of moderators, and 95% confidence intervals, as calculated by

$$\theta_i = \beta_0 + \beta_1 X_{i1} + \cdots + \beta_p X_{pi} + \varepsilon_i; \varepsilon_i \sim N(0, \tau^2)$$

where the value of the $p$th moderator for the $i$th study is defined as $X_{pi}$ and the amount of variability unaccounted for by the moderators is denoted as $\tau^2$ (Koricheva et al., 2013). To account for non-independence among measures from the same study, study was modeled as a random effect. The significance of moderators was tested using the omnibus test (Koricheva et al., 2013). The metafor package (Viechtbauer, 2010) in R (R Core Team, 2017) was used to calculate effect sizes.

The data collected from these studies was plotted in forest plots (mean with 95% confidence interval for each measure) to determine the overall effect sizes of studies, weighted by sample size (Figure 2). Significant moderators, as determined through the omnibus test, were displayed graphically (Figures 4-6).

**Limitations of Meta-analyses**

One limitation of meta-analyses is that their results are inherently dependent on the quality of studies that are being analyzed (Koricheva et al, 2013). For example, a well-designed
study that manipulates only one variable (i.e. the introduction of VSM) could be overwhelmed by more numerous studies that do not control for confounding variables as effectively. The use of moderators in this meta-analysis helps to address some of these concerns (Koricheva et al., 2013).

Another limitation of meta-analyses is the potential for publication bias (where the probability of publication depends on there being a significant effect) (Rosenberg, 2005). In order to test for publication bias, funnel plots were used (Figure 3). These are graphical methods for determining the probability of publication bias in a meta-analysis; if there is no evidence for publication bias, the funnel plot will be symmetrical (Rosenberg, 2005).

**Reliability, Validity, and Generalizability**

A meta-analysis allows for the determination of reliability of results across studies (Koricheva et al., 2013). In other words, if studies using VSM as an intervention consistently show improvement in student reading, this would suggest that VSM has good reliability as an intervention. The generation of forest plots in this study allowed for the determination of overall general patterns in the reliability of published literature.

Validity is more difficult to assess with a meta-analysis, as it relies on the validity of the underlying studies (Greco, Zangrillo, Biondi-Zoccai, & Landoni, 2013). For example, if one study demonstrates a non-significant result and uses a different assessment metric compared to other studies, it may be that the metric used in this study had low validity. Alternatively, the assessment metric may have had high validity, but the intervention was not an effective intervention for improving reading performance. Furthermore, lack of reliability in individual studies could also contribute to low validity (Greco et al., 2013). The validity of various metrics
can be triangulated using other literature such as qualitative studies and quantitative comparisons of metrics.

A meta-analysis is a useful tool in terms of generalizability. Rather than focusing on a single classroom or a small group of students, a meta-analysis incorporates all published literature in a specific area. However, generalizability is limited to the population of studies that meet the selection criteria (Greco et al., 2013) (e.g. if all studies were from Grade 1 classrooms in North America, then the meta-analysis may not be generalizable to Grade 5 classrooms in Europe).
Chapter 4

Findings and Results

Results of Electronic Database Search

Using electronic database searches, 26 papers were identified (Figure 1). An additional seven papers were identified via alternative sources, including a review of reference lists from previous systematic reviews. The titles and abstracts of all 33 papers were read and 21 papers were excluded based on lack of relevance to this meta-analysis. Of the 21, most were excluded because they were review, synthesis, or procedural papers. The remainder were excluded because they focused on factors outside of SLD, such as ELL or autism. After reading the remaining 12 papers in their entirety, one additional study was eliminated on the basis that the population studied involved preschool, and not school-aged, children. Overall, 11 papers were retained for this meta-analysis.

Many of the retained 11 studies used multiple reading assessments to determine the effectiveness of VSM on reading. A total of 29 data points were collected from these 11 studies, representing a combined tally of 69 students. These data points comprised both baseline and intervention scores and were combined to create a standardized mean difference score for each reading skill analyzed. For example, Ayala and O’Connor (2013) studied VSM with a group of 10 students and used four separate tests to measure reading. In order to ensure a comprehensive picture, data was pulled from all four tests. Study was included as a random effect to account for the similarity among measures (such as sample population remaining the same) within a study. In other words, it was assumed that the individual results within a study were more similar to one another than results between studies because the population generally remained the same within
the study. Removing this random effect and treating each data point as independent did not change overall results.

The publication date of the papers in this meta-analysis ranged from 1998 to 2017. Eight of the 11 studies were published in peer-reviewed journals and the remaining three were theses or research articles. Sample size from the 11 papers averaged 6.7 students with a range from three students to 11 students. All were elementary and middle school students.

**Meta-analysis Modeling Results**

The overall weighted mean effect size for the random effects meta-analysis using standardized mean difference (Hedges’ g) was 0.99 (95% confidence interval of 0.46-1.51; \( n=29 \)) (Figure 2). This mean effect size indicates that there was a significant positive effect on reading when using VSM (i.e. the 95% confidence interval did not overlap zero). This effect size corresponds to an increase in reading performance of nearly one standard deviation following VSM implementation.

The overall heterogeneity was \( Q=67.0 \) (\( p<0.0001 \)), which indicates significant variation between studies that was unaccounted for. This suggests that the inclusion of moderators in this study was warranted. The largest significant positive effects came from the study by Ayala and O’Connor (2013), whose mean measures ranged from 2.49-3.20 and did not overlap with zero. The smallest effect sizes came from the study by Edl (2008), whose mean measures ranged from -0.20-0.36 and whose confidence intervals all overlapped zero. The large, positive effect sizes, especially those whose confidence intervals did not overlap with zero, suggest that the VSM intervention effectively improved reading for students with, or at risk for, SLD in reading. Conversely, when effect sizes were smaller and their confidence intervals overlapped with zero,
they provided no evidence of a significant effect of VSM (Figure 2). The funnel plot (Figure 3) was largely symmetrical, suggesting little evidence of publication bias.

Figure 2: Forest plot of weighted effect sizes (standardized mean difference) with 95% confidence intervals for studies that reported data on the impact of VSM on reading. Size of point corresponds with precision of estimates. Confidence intervals that overlap the dashed vertical line at zero are not significantly different from zero. The overall impact of VSM on reading is displayed by “RE Model” and shows that VSM had a positive impact on reading. Note: names of authors were shortened to fit onto figure.
In this study, two moderators were tested: (1) number of VSM sessions and (2) grade of participants. Number of VSM sessions ranged from 4.75 (Wu & Gadke, 2017) to 32 sessions (Ayala & O’Connor, 2013), with an average of 10.8 sessions. Number of sessions showed a positive effect ($Q_M=29.2$, $p<0.0001$), suggesting that a greater number of sessions resulted in a
larger effect size (Figure 4). Grade of participants in each study ranged from Grade 1 (Ayala & O’Connor, 2013; Hitchcock et al., 2004; & Dowrick et al., 2006), to Grade 6.8 (Chandler, 2012). Grade of participants was also found to have an effect. Analysis showed that when the intervention was implemented with students at younger grades, the effect size was greater ($Q_m=6.4$, $p=0.01$) (Figure 5).

Figure 4: Scatterplot of number of sessions of VSM implementation on overall mean effect size from a random effects meta-analysis model.
Isolating the Effects of VSM

Six studies applied VSM as the sole intervention to support struggling readers. From these six studies, 12 data points were collected. Conversely, five studies applied VSM alongside one or more different interventions. From these five studies, 17 data points were collected. The
studies using VSM as the sole intervention were then compared to the studies using VSM alongside one or more other interventions.

For the studies using VSM only, the overall weighted mean effect size for the standardized mean difference (Hedges’ $g$) was 0.60 (95% confidence interval of 0.27-0.93; $n=12$) (Figure 6). In contrast, for the studies that applied VSM alongside other interventions, the overall weighted mean effect size for the standardized mean difference (Hedges’ $g$) was 1.16 (95% confidence interval of 0.28-2.05; $n=17$). These results imply that implementing VSM alone can improve reading performance among struggling readers by 0.60 of a standard deviation. However, implementing VSM alongside other reading interventions resulted in an even greater effect; in this case, reading performance was improved by 1.16 standard deviations.
Figure 6: Confidence interval plot of the effect sizes of VSM alone versus VSM applied alongside one or more other interventions.
Chapter 5

Discussion

Summary: Effectiveness of VSM for Students with, or at risk for, SLD in Reading

Video self-modeling has been used as an intervention to improve reading outcomes in school-aged students for more than 20 years. However, the effectiveness of this reading intervention has not been quantitatively synthesized to date. In this meta-analysis, VSM was found to have a significant effect on reading performance among students with, or at risk for, SLD in reading. The most effective implementations of VSM occurred when the number of sessions was highest, when students were at lower grade levels, and when VSM was applied alongside other reading interventions. These findings point to the overall effectiveness of VSM as a reading intervention for students with, or at risk for, SLD in reading and indicate the importance of early and intensive intervention.

Teachers striving to support students with SLD in reading have numerous interventions to choose from to help their students improve their reading. Determining which of these interventions to use in a given situation is impacted by a multitude of factors including student characteristics (severity of delay, area(s) of struggle, previous interventions used with the student(s), and number of students requiring intervention) (PRIME Project, n.d.), cost, time required, level of training required of the interventionist, and perceived effectiveness of the intervention (Denton et al., 2003). While the effectiveness of various approaches has been previously studied (Scammacca, et al., 2007; Scammacca, Roberts, Vaughn, & Stuebing, 2015; Wanzek et al., 2018), there are few meta-analyses that have focused on specific reading interventions, and no meta-analyses have been conducted to date on the effectiveness of VSM. This current meta-analysis synthesizes the disparate literature into one common statistical
framework and indicates that VSM has the potential to be a valuable intervention for supporting students with, or at risk for, SLD in reading. This, in turn, will help teachers to efficiently decide if VSM will be effective for their particular student(s).

**VSM Links to the Zone of Proximal Development and Efficacy Beliefs**

Many students with, or at risk for, SLD in reading experienced improvement in reading performance following interventions that used video self-modeling. VSM has its roots in the zone of proximal development and scaffolding (Ayala & O’Connor, 2013). With proper VSM implementation, students are working within their zone of proximal development to develop reading skills that are just beyond their current ability. Through time, the intervention becomes increasingly difficult, as skills become fluent, and the student’s zone of proximal development shifts.

Efficacy beliefs play a very important role in VSM. The videos that students view show them experiencing success while reading texts that are beyond their current independent ability, thus building their confidence. Since confidence in reading ability leads to better reading outcomes (Linnenbrink & Pintrich, 2003; Quirk et al., 2009) this is a truly positive and unique aspect of the VSM approach.

**Effect of Moderators**

The moderators that were tested in this meta-analysis had significant effects in the directions hypothesized. An increased number of sessions resulted in a greater effect size; in other words, a greater number of VSM sessions resulted in larger gains in reading performance for students with, or at risk for, SLD in reading. Accordingly, teachers should aim to implement a greater number of VSM sessions when using this intervention, in order to maximize success among struggling readers.
Age of participant also impacted effectiveness of VSM interventions. As hypothesized, the younger the students were at the time of intervention, the greater the effect size. While there was improvement in reading for students at higher grades, implementing VSM with students in their primary years of schooling was most beneficial. These findings mirror previous meta-analyses that show larger effect sizes for younger readers across a variety of interventions (Scammacca et al., 2007). The results of the current meta-analysis highlight the importance of early interventions for improving reading outcomes for students with, or at risk for, SLD in reading.

Finally, introducing two or more interventions simultaneously resulted in a greater effect size, compared to implementing VSM alone. Since the goal of using many interventions is to improve reading outcomes, it becomes difficult to ascertain which of the interventions is most effective. This is somewhat problematic and will require future research.

Limitations and Suggestions for Future Research

As discussed previously, meta-analyses are inherently dependent on the quality of studies being analyzed. The published literature on VSM is inconsistent, with multiple populations, ages, implementation types, and frequency of interventions being applied. Moderators were incorporated to attempt to control for some of this variability, but there is much variability that remains unexplained.

In this meta-analysis, several studies employed one or more interventions simultaneously, making it difficult to ascertain the effectiveness of each intervention on its own. Future research would benefit from a quantitative comparison of VSM to other reading interventions. Similarly, it would be beneficial to determine if combining VSM with other interventions would result in a multiplicative effect, or if one intervention is vastly superior to the other and is positively
skewing the results of the second intervention. Other facets of future research to consider should include larger sample sizes and the use of control groups. Acquiring a better understanding of the effectiveness of VSM on improving reading outcomes for students with SLD in reading could result in more teachers using this intervention and improved reading performance among struggling students.

**Conclusion**

Overall, this meta-analysis of existing research indicates that video self-modeling is an effective intervention for improving the reading performance of students with, or at risk for, SLD in reading. The influence of moderators was tested, and VSM was found to be most effective when applied frequently and with students at early grade levels. Furthermore, VSM was often applied alongside other interventions, which yielded greater results than when it was applied alone. Therefore, to yield the most effective results, primary level teachers should be encouraged to (1) incorporate VSM early on, (2) implement VSM at a high frequency, and (3) use VSM alongside other reading interventions.
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