An Exploratory Investigation on the Effects of an Electronic Recording System for Repeated Reading

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AN EXPLORATORY INVESTIGATION ON THE EFFECTS OF AN ELECTRONIC RECORDING SYSTEM FOR REPEATED READING

by

Seajae Calvin Hartness

A Dissertation
Submitted to the Graduate School of The University of Southern Mississippi in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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May 2011
AN EXPLORATORY INVESTIGATION ON THE EFFECTS OF AN ELECTRONIC RECORDING SYSTEM FOR REPEATED READING

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ABSTRACT

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Repeated Reading is a common reading intervention that has been used to help students read fluently since 1979. There are many variations of Repeated Reading that have been investigated and found to be effective. However, there is a relative research deficit on the effectiveness of software programs for administering Repeated Reading. This exploratory research project examined the effectiveness of Repeated Reading with an electronic recording system. The performance of the electronic Repeated Reading group was compared to the performance of participants who received traditionally administered Early Intervention Program services. The results suggest that electronically scored Repeated Reading is as effective as traditionally administered Early Intervention Program services.
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LIST OF ABBREVIATIONS

SES - Socio-economic status
NCLB – No Child Left Behind
IDEA – Individuals with Education Act
IDEIA – Individuals with Education Improvement Act
R-CBM – Reading Curriculum-based Measurement
DIBELS - Dynamic Indicators of Literacy Skills
CBM – Curriculum-based Measurement
WCPM – Words Correct Per Minute
GORT – Gray Oral Reading Tests
RTI – Response To Intervention
CIPM - Correct Items per Minute
EIP - Early Intervention Program
MANOVA - Multivariate Analysis of Variance
GLOSSARY

Curriculum-based measurement (CBM) – Is a general outcome measure designed to evaluate students’ progress towards long term objectives in reading, written expression, mathematics, and spelling. CBM uses fluency as its primary metric. CBM can be used for formative assessment and is useful for instructional programming.

Curriculum-based assessment (CBA) – Is a subskill mastery measure used to assess a student’s performance on various tasks within an instructional unit. CBA can be used formatively and is useful for instructional planning. CBA data are used in a criterion-referenced fashion.

Correct items per minute (CIPM) – How many words a student reads correctly per minute.

Individuals with Disabilities Act (IDEA) – Is special education legislation that was reauthorized in 2004 that specifies federal funding to local education agencies, delineates student/parent rights, and specifies the relationship between the local education agency, students, and parents. The law also specifies the responsibilities of state and local agencies in determining which special education eligibility model the local education agency can use; the law allows state agencies to require a Response to Intervention approach but does not allow state governments from prohibiting it at the local education agency level.

Repeated Reading – An evidence-based reading intervention where a student reads and then rereads a passage several times. During this intervention the student is
provided the correct word if they read a word incorrectly or pause on a word for three seconds. Repeated reading is evidence-based for improving students’ reading accuracy, fluency, and comprehension.

Response to Intervention (RTI) – Is an approach to education where students are provided increased levels of support organized into tiers of intervention and progress monitoring that is used to prevent, identify, and remediate academic deficits as well as behavioral problems.

Sight Words – Sight Words are frequently occurring words that students are expected to read fluently. Sight Word lists vary by grade and publisher.
CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

New federal legislation including No Child Left Behind (NCLB) and the Individuals with Disabilities Education Improvement Act (IDEA) advocate for early intervention programs more than ever (Individuals with Disabilities Education Improvement Act, 2004; No Child Left Behind, 2001). As such, school personnel are being asked to implement research-based interventions to a diverse group of students with increased accountability for student outcomes (Lewis & Newcomer, 2002). Schools are required to demonstrate that students make adequate yearly progress which is measured, in part, by a valid and reliable measure of achievement and higher graduation rates (U.S. Department of Education, 2006). Data are examined by ethnic group, socio-economic status (SES), students with disabilities, and English language learners, with each group being expected to have a 10% reduction in the group number identified as below proficiency. The proficiency indicators are academic assessments that are decided at the state level and thus vary from state to state. Schools that do not meet annual yearly progress standards can be penalized (e.g., reduced federal funding). Increased accountability also requires teachers to conduct empirically validated interventions and generate more data than they may have been trained to collect. Laws that are related to NCLB include the Individuals with Disability Education Act (IDEA) and its reauthorization into the IDEIA (Individuals with Disabilities Education Improvement Act, 2004). IDEIA promotes a Response to Intervention (RtI) model for early identification and intervention of learning problems prior to considering special education
placement. IDEIA does this by allowing states to implement an RtI model as opposed to those previously used (e.g., IQ-Achievement discrepancy model).

The systems level change promoted by IDEA and NCLB typically does not occur rapidly and may require the systematic application of the problem solving model (Curtis & Stollar, 1996). School psychologists generally have more training in problem solving models than regular education teachers and thus may be sought out to meet the increased demands of accountability (Kerwin, 1995). Unfortunately, the ratio of school psychologists to teachers is low, and even lower to students, which suggests that school psychologists need an organized and efficient approach to knowledge dissemination and data management (Thomas, 2010).

Given the small number of school psychologists available to teachers and students, it is troublesome that many students experience academic difficulties that require consultation from someone outside the classroom (e.g., school psychologist). Reading is one of the core academic areas defined in IDEA in which elementary students commonly have problems (IDEIA, 2004). The prevalence of students with reading problems was documented in a large group study by Pinnell et al. (1995) who conducted an investigation as part of the Integrated Reading Performance, which was a nationally administered measure funded by the National Assessment of Education Progress. The study examined the oral reading fluency and comprehension of over 1,000 fourth graders. Students in the study read a 319-word story silently twice. Next, the students answered comprehension questions. The students then read the same story aloud, and the examiner scored their reading on a four-point scale with ratings of one and two representing nonfluent reading. They found that only 55% of fourth grade students read fluently.
Furthermore, they found a significant relationship between oral reading fluency and comprehension. They indicated that higher scores on reading fluency were associated with higher comprehension scores but neither a numerical index nor detailed description of this relationship was provided. Unfortunately, this study found that 45% of students did not demonstrate fluent reading.

Many elementary students may have difficulty with reading fluency (Pinnell et al., 1995), and while new legislation addresses the issue via the required implementation of empirically-based interventions such as Repeated Reading, there is a paucity of research on how to assist accurate implementation of these interventions by classroom teachers. The purpose of the present study is to examine whether Repeated Reading using an electronic recording system is as effective as traditionally administered school-based reading services.

Reading Fluency

Reading fluency is how quickly and accurately a person can read. Fluent readers “read connected text rapidly, smoothly, effortlessly, and automatically with little conscious attention to the mechanics of reading” (Meyer & Felton, 1999, p. 284). Reading fluency can be measured as oral reading fluency or silent reading fluency. Typically, reading fluency is discussed in terms of oral reading fluency because oral reading fluency is directly observable, whereas silent reading fluency is not. Problems with oral reading fluency are common in poor readers (Mathes, Simmons, & Davis, 1992; Pinnell et al., 1995). Slow reading may negatively impact students in a variety of ways. First, slow reading may cause students to take longer to complete assignments (Mastropieri, Leinart, & Thomas, 1999). Second, slow readers may become frustrated
when their peers finish work and move onto other activities while they are still working on their reading assignments (Mastropieri et al., 1999). Third, reading fluency is one of the strongest predictors of reading comprehension; so poor reading fluency may lead to problems with comprehension (Hintze, Callahan, Matthews, Williams, & Tobin, 2002; Pinnell et al., 1995).

Interventions for Reading Fluency

There are many empirically-based interventions for reading fluency deficits. They typically involve the student reading with the help of an advanced reader who provides feedback on mistakes and hesitations (e.g., 3-5 s pauses). The primary difference between most of the intervention procedures is what verbal behaviors are required of the student when they hesitate or miss a word. Another major variation is whether or not there is a rereading component. The Neurological Impress Method was one of the first formal reading fluency interventions. The Neurological Impress Method includes the student and teacher reading in unison (Kann, 1983). With the Neurological Impress Method, the teacher-student dyad attempts to maximize student exposure to print by covering as much text as possible (Kann, 1983). The Neurological Impress Method is a relatively simple intervention for oral reading fluency (Flood, Lapp, & Fisher, 2005), but became unpopular because the effectiveness of the intervention is unclear. Although the intervention is not considered an evidenced-based intervention, it was important because it is credited for its influence on the development of the effective interventions that followed it, including Repeated Reading, Assisted Reading Practice, and Paired Reading (Therrien, 2004). The following paragraphs will discuss reading interventions for oral reading fluency that emerged after the Neurological Impress Method.
**Assisted Reading Practice**

In Assisted Reading Practice students read a story aloud simultaneously with a teacher or an audio tape and are corrected when they make a mistake or hesitate for five seconds (Gilbert, Williams, & McLaughlin, 1996; Shany & Biemiller, 1995). Shany and Biemiller conducted Assisted Reading Practice with 19 students in Canada. They also had a control group of 10 students who did not receive Assisted Reading Practice. Students were nominated for the study by their teachers and then screened out if they were not in the bottom 25% of their grade, made less than 10 errors on the Biemiller Test of Reading Processes (Biemiller, 1981), or failed half of the first grade comprehension questions. The students were then randomly assigned into a teacher assisted, tape assisted, or control group. The authors employed a pretest/posttest design using the score on the reading portion of the Canadian Test of Basic Skills (Biemiller, 1981) as the primary dependent variable and the Biemiller Test of Reading Processes, the Wide Range Achievement Test—Revised (Wilkinson & Robertson, 1984), Durrell Analysis of Reading Difficulty Oral Reading subtest (Durrell & Catterson, 1955), and the Woodcock Word Attack Mastery Test (Woodcock, 1973a) Word Attack subtest as secondary dependent variables. The results suggested that both the teacher-led condition and taped condition were effective for increasing reading rate and comprehension, but not decoding ability.

Gilbert et al. (1996) conducted Assisted Reading Practice with three Canadian elementary students diagnosed with learning disabilities. The three participants employed in the study demonstrated gains on oral reading fluency probes. The Assisted Reading procedure employed in the study included components of Listening Passage Preview and
Repeated Reading, which is different from the original Assisted Reading Practice intervention. The students read each passage four times. During the first reading they followed along silently with the audio tape. On the other three readings they read aloud with the audio tape. The researchers varied from the traditional reading curriculum based measurement (R-CBM) procedure in that oral reading fluency was determined by the student’s reading of the entire story as opposed to the traditional method where performance on only the first minute of reading is recorded to determine reading fluency.

Paired Reading

In Paired Reading the target student reads along with the interventionist (Cadieux & Boudreault, 2005; Carbo, 1996; Morgan, 1976). Generally the interventionist is a peer tutor, but can also be a teacher or parent. The pair read most of the story aloud in unison, but the interventionist stops reading aloud at random times to provide the target student an opportunity to read independently. If the target student makes a mistake during their independent reading, he or she is immediately corrected by the tutor who then resumes reading aloud with the target student.

Cadieux and Boudreault (2005) demonstrated the effectiveness of Paired Reading at improving the average score of 54 students on the Otis Lennon Level 1 Test (Otis & Lennon, 1981) and the Brigance Inventory of Early Development (Brigance, 1995). The interventionists in this study were the participant’s parents. The Paired Reading session started with the student selecting the reading material and then reading simultaneously with the parent. Next, the student signaled to the parent that they were ready to read independently. In this study, the students were not corrected until four seconds after they made the mistake, which is atypical. The rationale for this procedural variation was to
provide the students with four seconds to self correct mistakes. Parents were trained to point out each word if their child skipped words. The study methodology was also atypical in that the parents were instructed to stop the intervention session and praise the student’s effort if the student appeared off-task or tired at any point during the session. Parents were instructed to implement the intervention for no more than 15 minutes unless the student requested to do so. The procedure was implemented at the parent’s home unsupervised. The permanent product used to assess treatment integrity was an “X” that parents were supposed to mark on the calendar when they implemented Paired Reading. Students in the experimental and control group made progress on the dependent academic variables, possibly due to maturation or ongoing instruction in the school, but the students in the experimental group made more progress; on the Otis Lennon Level 1 Test the experimental group improved 18.6 points whereas the control group improved 14.7.

*Error Correction Strategies*

Error correction refers to a group of procedures that require the student to repeatedly practice correct responses following a mistake (Worsdell et al., 2005). Word Supply, Sentence Repeat, Word Attack, and Phrase Drill are four procedures under the umbrella of error correction strategies. In Word Supply the student orally reads a passage to an advanced tutor. If the target student makes a mistake, the tutor corrects the student (Jenkins & Larson, 1979; Rose, McEntire, & Dowdy, 1982; Rosenberg, 1986). The student repeats the corrected word one or several times before continuing to the next word. Sentence Repeat is a similar procedure, but with Sentence Repeat the student rereads the entire sentence if they make an error (Jenkins & Larson, 1979). In Phrase Drill the student reads phrases that contain the unknown target words the student is trying
to master (Daly, Murdoch, Lillenstein, Webber, & Lentz, 2002). It is different from the others in that the student reads phrases as opposed to entire passages and also in that it incorporates the interspersal of unknown and known words.

Barbetta, Heward, and Bradley (1993) demonstrated that error correction was effective at increasing the sight word recognition of five students with developmental delays. The students were in a self-contained setting and were eight or nine years old. All of the students read at a first grade or lower reading level as determined by the Wide Range Achievement Test (Wilkinson & Robertson, 1984). An alternating treatments design was used to examine the effectiveness of error correction in comparison to teacher modeling of the correct response. Intervention sessions occurred daily, and the teacher presented flashcards containing sight words to the student. The teacher asked the student to identify the word. The authors employed two variations of error correction. In the whole-word condition, students were provided with the target word when they made a mistake and were then asked again to identify the target word. In the phonetic-prompt condition, students were provided with the initial sound of the target word when they made a mistake. Students were not provided with the whole word during the phonetic-prompt session, and if the student did not correctly identify the word after the hint, the teacher went on to the next flashcard. Correct responses were praised in both intervention conditions. The dependent variables were number of words read correctly on same-day tests, percent of words read correctly during intervention trials, and percent of words read correctly on maintenance tests. The whole-word error correction was the most effective.

Worsdell et al. (2005) demonstrated that requiring students to repeat corrections one time following a mistake was effective, but not as effective at increasing sight word
recognition as requiring students to repeat corrections five times per mistake. The participants were adults with mild or moderate mental retardation. Six of the participants also had a diagnosis of Prader-Willi Syndrome. Jenkins and Larson (1979) conducted one of the few studies examining multiple forms of error correction. They examined the effect of no correction (i.e., baseline), Sentence Repeat, End of Page Review, Word Meaning, and Drill on sight word accuracy and words in context with five junior high students. Sentence Repeat required students to repeat the entire sentence if they made a mistake before being allowed to go onto the next sentence. They found that the students improved across treatment conditions, and that they outperformed a control group. Word Supply consisted of providing the student with immediate corrective feedback when they made an error. The student then repeated the corrected word before continuing onto the next word. End of Page Review consisted of providing the student with corrective feedback on errors. The student then repeated the word before continuing onto the next word. End of Page Review was different from Word Supply in that the teacher wrote down errors and the student had to read each word a second time after completing the passage. Word Meaning consisted of Word Supply plus the teacher asking, “What does this word mean?” and providing a synonym following incorrect or no response from the student. Teachers used a dictionary, as needed, to come up with the synonyms. Drill was a combination of several forms of error correction. Students were provided corrective feedback on errors, the errors were written on index cards, and after reading the passage the students were asked to read the words on the flashcards individually until they correctly identified the card on two consecutive presentations. Drill was the most effective intervention at increasing sight word recognition and words in context. One
limitation of the study was that all of the students experienced the treatments in the same order which may have resulted in order effects. Another limitation is that the intervention sessions lasted approximately 35 minutes, but there was not a control for time with some interventions (e.g., Drill), possibly requiring more time than simpler procedures.

Overall, the effectiveness of error correction procedures are well documented in the literature. One of the reasons that specific error correction procedures do not have more consistent documentation is that they are not consistently applied across settings and are often incorporated into other interventions such as Repeated Reading and Listening Passage Preview, making the unique contribution of the error correction component difficult to decipher. Alber-Morgan, Ramp, Anderson, and Martin (2007) examined the effect of error correction, Repeated Reading, and performance feedback on reading fluency. The error correction procedure employed was that student errors were recorded on a flashcard and the student was told to read the words they missed after they had finished reading the passage. Alber-Morgan et al. found that Repeated Reading with error correction increased the oral reading fluency for three of the four participants. However, the study only compared Repeated Reading with error correction to Repeated Reading without error correction, which did not allow for statements about error correction alone to be made.

*Listening Passage Preview*

Listening Passage Preview is an empirically-based reading intervention for oral reading fluency and accuracy (Daly & Martens, 1994; Daly, et al., 2002; Eckert, Ardoin, Daly, & Martens, 2002). With Listening Passage Preview, the teacher first reads the passage aloud to the student. The student follows along silently as the teacher reads. It is
the student’s turn to read once the teacher has finished the passage. The teacher provides corrective feedback when the student makes a mistake or hesitates for five seconds. Listening Passage Preview can also be combined with other interventions (e.g., Repeated Reading) and can even be modified to fit group settings (Begeny & Silber, 2006). Daly and Martens demonstrated the effectiveness of Subject Passage Preview, Taped Words, and Listening Passage Preview within a brief experimental analysis of reading interventions. Their investigation found that of the interventions employed in the study, Listening Passage Preview was the most effective for 75% of the participants (i.e., three of four students) for increasing their oral reading fluency as well as accuracy.

Daly, Murdoch, Lillenstein, Webber, and Lentz (2002) examined the effects of Listening Passage Preview, Repeated Reading, Easier Materials, Phrase Drill, Sequential Modification, Word List, and Contingent Reward with an experimental analysis. Daly et al. found that interventions with a Listening Passage Preview component were effective at improving the oral reading fluency of the students. Eckert, Ardoin, Daly, and Martens (2002) conducted an experimental analysis with combinations of Listening Passage Preview with Repeated Readings with and without contingent reinforcement and performance feedback. Eckert et al. found that contingent reinforcement improved the effectiveness of Listening Passage Preview with Repeated Readings for increasing the oral reading fluency of four of the six participants on intervention material. However, assessment using novel probes did not suggest generalization of oral reading fluency to novel probes for most of the participants.
Repeated Reading

Repeated Reading was developed by Samuels (1997), and set the stage for a new era in fluency interventions focused around guided reading procedures. It is a teaching method targeting fluency and comprehension (Mastropieri et al., 1999). In Repeated Reading students reread passages of connected text aloud multiple times (Samuels, 1997). Corrective feedback is provided when students make a mistake or hesitate on a word for five seconds. Students advance to new passages after a set number of readings or when they reach a fluency criterion (e.g., 100 correct words per minute). Once the student has met the criterion for advancement, a new passage is presented and the Repeated Reading procedure is repeated.

There are some procedural variations on the advancement criterion. Rashotte and Torgesen (1985) have recommended four readings per passage based on the finding that students make most of their fluency gains on intervention material by the fourth reading. This is a simple rule that is easily communicated to teachers and students but that does not take the student’s performance into account. Others have argued that some students may find graduating to a new passage following mastery performance rewarding and thus recommend having the student reread the passage until meeting a fluency criterion. The effectiveness of Repeated Reading has been demonstrated in numerous studies (Moyer, 1982; Sindelar, Monda, & O’Shea, 1990; Therrien, 2004; Valleley & Shriver, 2003). The following paragraphs summarize some of the research that has been conducted on Repeated Reading.

Homan, Klesius, and Hite (1993) examined the effect of Repeated Reading on comprehension using 26 sixth graders who were reading at a fourth and fifth grade
reading level. The Silver, Burdett, and Ginn Basal (Pearson et al., 1989) reading series was used during the instructional assessment. There were two controls for passage difficulty. The first was the readability of the passages and was determined by the Fry (Fry, 1968) and Bormuth (Bormuth, 1969) formulae. The second control for passage difficulty was by counterbalancing the passages used during pre- and post-testing. The study compared Repeated Reading to Assisted Nonrepetitive Reading strategies such as Echo Reading, Cloze Reading, and Unison Reading. However, the directions for Repeated Reading were modified in that students were told that there would be a retell component prior to reading the passages. Furthermore, the corrective feedback during Repeated Reading was provided by peers. Intervention was implemented for 20 minutes, three times a week, over seven and a half weeks. The dependent measures were oral reading fluency, errors, and retellings. The results suggested that the interventions were equally effective. A limitation of the study was that the teachers in the classrooms were not working with the students one-to-one for most of the Repeated Reading sessions, and the peers’ skill in providing corrective feedback was uncertain. Therefore, this study may not have provided a valid evaluation of Repeated Reading because important and potentially critical procedural variations were excluded.

Sindelar, Monda, and O’Shea (1990) compared the effects of Repeated Reading in students with learning disabilities to that of their peers. The group design study collected data from 50 participants, half of whom had been diagnosed with a learning disability. The students’ reading classification was confirmed with reading curriculum-based measurement (R-CBM) procedures. The experimenters then conducted Repeated Reading with two stories for each student. The dependent measures were correct words
per minute, errors per minute, and story retell. Story retell was defined as the number of correct propositions the student was able to produce when asked to recall as much as they could remember about the passage. The results suggested that Repeated Reading increased reading fluency for students with and without learning disabilities. The story retell dependent measure was only statistically significant for the number of times the student read the story, with students having better recall after reading the story three times than when they read it only once.

Therrien (2004) conducted a meta analysis of the Repeated Reading literature. He included all experimental studies published on school age children after 1977. The database of articles examined in the study was identified through the Education Resources Information Center and Psychological Information databases that were identified when Repeated Reading, reading fluency, reading automaticity, reading speed, reading accuracy, and reading rate were used as search terms. Therrien also included all of the articles referenced by the National Reading Panel (2000). Fifteen studies were eliminated because there was not sufficient information required to calculate effect size(s). Studies were then grouped by whether or not the study included a nontransfer (i.e., intervention material) or transfer (i.e., novel material) passage to evaluate student progress. Twenty-eight of the studies had a nontransfer dependent variable (i.e., students’ performance was measured using the passage read multiple times.

The effect size for the nontransfer group was .83 for fluency and .67 for comprehension, suggesting that Repeated Reading is effective in improving fluency and comprehension with intervention materials. When students were cued to focus on speed, the effect size was .72 for fluency and .66 for comprehension. When students were
informed they were reading for comprehension, the effect size was .81 for fluency and .75 for comprehension. This suggests that cueing students to focus on comprehension may be associated with larger gains in fluency and comprehension.

The coefficients from the meta analysis for the nontransfer studies were similar to the effects of the transfer studies. The effect size for the 27 transfer studies was .50 for fluency and .25 for comprehension. These effect sizes were expected to be smaller because nontransfer dependent measures are less sensitive to short term gains. A common variation with the transfer studies was whether the corrective feedback was provided by a teacher or peer. The effect size for teacher implemented Repeated Reading was 1.37 for fluency and .71 for comprehension. The effect size when peers provided the corrective feedback was .36 for fluency and .22 for comprehension. This finding suggests that adult mediated Repeated Reading, rather than peer mediated is a more effective method of intervention delivery. Eleven studies employed Listening Passage Preview with Repeated Reading. An interesting finding was that all of the studies that included Listening Passage Preview with Repeated Readings used peers to provide corrective feedback. The effect size for Listening Passage Preview with Repeated Reading was .40 for fluency and .10 for comprehension. Twenty-three studies used corrective feedback. The effect size for fluency when corrective feedback was used was .51 for fluency and .23 for comprehension. When a fluency criterion was required for advance to a new passage then the fluency effect size was 1.70. When the criterion was a specified number of readings then the fluency effect size was .38. These effect sizes suggest that Repeated Reading was more effective on generalization measures when a fluency criterion is used for advancement to the next passage. The analyses also included whether or not the student’s
progress was graphed. The effect size for graphing was 1.58 for fluency suggesting that Repeated Reading with graphing was effective.

In summary, there are a variety of procedures that are research supported for improving students’ reading accuracy and fluency. Some procedures (e.g., Repeated Reading, Listening Passage Preview) have been demonstrated effective when in isolation. However, other procedures (e.g., error correction) have primarily been evaluated when implemented as part of a multi-component reading intervention package. Regardless, multiple procedures are available to assist school personnel when attempting to improve the reading performance of students who struggle with reading.

*Computer-Based Reading Interventions*

There are several computer programs for improving literacy skills. Many of the programs focus on drills and games where the student interacts directly with a computer program using a keyboard and mouse. There is typically little response effort required from the teacher for students to engage in educational computer programs and websites. It is not surprising then that the most popular computer programs and websites are designed to be used with all students to supplement the curriculum rather than to be an intense intervention for struggling students. The following paragraphs will first summarize the research on an important supplementary program called Accelerated Reader before continuing on to programs designed to be interventions for struggling readers.

*Accelerated reader.* Perhaps the most prevalent computer program for improving literacy skills is Accelerated Reader, which has been implemented in over 65,000 schools (Nunnery, Ross, & McDonald, 2006). The publisher, Renaissance Learning (2009)
suggests that it fits “perfectly” into Tier I, II and III of the RtI model, but it is generally seen as a supplementary program. Accelerated Reader encourages students to engage in reading by providing comprehension tests on many popular books. Students read stories independently and/or with adults, then independently take the comprehension tests at a computer. Students are awarded points for correct answers. Students can then exchange the points for prizes. Points are tracked by class and the class that obtains the most points is offered a prize. Nunnery, et al. conducted one of the few experimental studies on Accelerated Reader and demonstrated that experimental groups made more progress on STAR Reading performance than control groups. STAR Reading is a computer program that assists Accelerated Reader. STAR Reading produces a scaled score with a range from 0 to 1400. The split-half reliability of STAR Reading is .90, and the construct validity has been demonstrated with the California Achievement Test (CTB/McGraw Hill, 2009), Comprehensive Test of Basic Skills (CTB/McGraw Hill, 2009), the Gates-MacGinitie Reading Test (MacGinitie, MacGinitie, Maria, Dreyer, & Hughes, 2006), the Stanford Achievement Test, and the Iowa Test of Basic Skills (Nunnery et al., 2006; STAR Reading, 2001) as criterion measures. One limitation of Accelerated Reader is that it costs between $30,000 and $75,000 per school which may be too expensive for some schools. Another limitation of Accelerated Reader is that it focuses on comprehension and ignores fluency. Additionally, Accelerated Reader appears to primarily include rewards and encouragement for reading as opposed to providing a structured, systematic method for teaching reading skills (e.g., phonics, fluency).

*TELE-Web*. Englert, Zhao, Collings, and Romig (2005) examined the effectiveness of TELE-Web. TELE-Web is a website that uses a cloze procedure where
students read five sentence passages and then select the word that “goes in the blank” from a list of options. There were five response options from which the student could choose. Each response option was a sight word. The cloze procedure was originally developed as an assessment procedure but was modified to an intervention procedure by having an electronic button the student clicks on with the mouse to have it read for them. Sixteen students in a low socioeconomic status (SES) special education classroom participated in the intervention for a total of 160 minutes over a four week period. The dependent measure was score on the Star Reading Test which was administered three times. The STAR Reading Program uses a cloze procedure where a student reads a sentence and selects a word out of four response options that goes in the blank. There was a control group that received a pen and paper version of the TELE-web exercises. All students made improvements, but there was not a control for maturation, which limited the conclusions that can be drawn from the study.

Read 180. Aguhob (2006) reported the results of a study with Read 180 with approximately 300 ninth and tenth grade students across seven schools. Students were randomly assigned to Read 180 classrooms. Aguhob reported in a footnote that the optimal amount of time students should spend engaged in Read 180 was 20 minutes per day but it was unclear how much time the students in this study actually spent engaged in Read 180 activities. The report suggested that student engagement in Read 180 varied by school but an explanation of this variation was not provided. It is possible that the time the students spent engaged in Read 180 was decided at the teacher level. Aguhob reported that ninth and tenth grade students who used Read 180 for one academic year made more growth than the control group on the Florida Comprehensive Assessment
The results were reported in grade equivalent scores which are problematic because grade equivalent scores have many problems (Allen & Yen, 1979). Nevertheless, Aguhob reported that the ninth graders made an academic year’s worth of improvement on the Florida Comprehensive Assessment Test.

*Fast ForWord Language Software.* Fast ForWord Language Software is an internet-based program that is based on a neuropsychological model for language and literacy development. It is based partly on an information processing theory in that language impairments may cause a slow rate of processing which then might impact literacy development. The second part of the hypothesis is that the brains of students with phonological deficits get “rewired” by modifying the properties of speech sounds (e.g., speed). The program is presented as a way to make unique modifications to the neurology of the brain and may be a misuse of brain plasticity theory, which suggests that all learning affects the neurology of the brain at some level. It is a program that attempts to correct inefficient cognitive processing by somehow facilitating the development of brain regions associated with language and literacy. Fast ForWord may be an appealing web application because it does not require personnel resources as instructional sessions are delivered via a web-based application. Unfortunately, little research is available demonstrating the effectiveness of Fast ForWord in improving students’ reading performance.

The Scientific Learning Corporation provides many research white papers on their website. The white papers are published by the Scientific Learning Corporation as opposed to peer review journals. The white papers consist mostly of quasi experimental designs. The white papers are designed to document FastForward’s effectiveness on
various state reading tests but it is difficult to evaluate the product from the white papers given the methodological limitations. The Florida Center for Reading Research reviewed the Fast ForWord Language Software (2007). The review of Fast ForWord critiqued the product for selectively reporting dependent variables (e.g., not reported Letter-Word Identification subtest of the Woodcock-Johnson Psycho Educational Battery-Revised (Woodcock, 1973a) and not using control conditions. The review listed several strengths of the program (i.e., engaging activities, provides quality feedback to students, effective at improving oral language skills). The reviewers noted Fast ForWord’s indirect approach to teaching reading skills as a weakness of the software.

In summary, there are many computer-based programs for literacy. Unfortunately, the evidence in support of computer-based programs for literacy is limited. Despite the lack of evidence, computer-based programs are routinely used in schools. As stated previously, computer-based programs may be attractive to schools because computer-based programs typically require few if any personnel resources. Instruction and intervention are typically provided to a student in the absence of an adult.

**Curriculum-Based Measurement**

There are several reading interventions that are evidence-based for improving students’ reading accuracy, fluency, and comprehension (e.g., Repeated Reading, Listening Passage Preview). Regardless of which reading procedure is chosen, it is important to monitor students response to instruction as students may respond in an idiographic fashion to evidence-based procedures (Dufrene & Warzak, 2007). Reading fluency may be assessed and progress monitored via CBM procedures. R-CBM includes listening to students read passages aloud for one-minute. Then, the proctor records words
correct per minute (WCPM) and errors per minute (EPM). R-CBM is an index of reading speed and accuracy. It can be used for several purposes including use as a general outcome measure of the student’s overall reading proficiency (Fuchs & Deno, 1991). It can also be used to measure a specific skill (e.g., subskill mastery measurement). CBM, including R-CBM, was developed through a series of research projects led by Stanley Deno from 1977 to 1983 (Deno, 1985). Prior to Deno’s work there was a general consensus regarding the need for progress monitoring, but lack of psychometrically sound and feasible methods for doing so (Deno, 1985). Teachers typically made educational decisions based on their informal impressions from interacting with the student in the classroom (Deno, 1985). The goal of Deno and colleagues research was to find a way to use material from the curriculum to reliably and validly monitor student achievement (Deno, 1985; Fuchs & Deno, 1991). The series of investigations identified R-CBM by demonstrating the reliability and validity of reading aloud activities (Deno, 1991). The criterion validity of R-CBM has been demonstrated by comparing the results from R-CBM to standardized achievement tests. Additionally, the measures have been able to discriminate between students receiving special education from students who were not (Deno, 1991).

R-CBM has also been demonstrated to have strong predictive validity with many outcome measures (Good, Simmons, & Kame’enui, 2001; Hintze & Silberglitt, 2005). For example, Hintze and Silberglitt (2005) conducted a longitudinal study in which they examined the R-CBM data for 1,766 students as they went from first to third grade. This large study found that R-CBM data accurately predicted students’ scores on the Minnesota Comprehensive Assessment test (Minnesota Department of Education, 2003).
The results suggested that R-CBM data were a better predictor of future score on the Minnesota Comprehensive Assessment Test than the Minnesota Comprehensive Assessment Test was at predicting future performance on a parallel form. Technically, no test can correlate stronger with its true score than the test itself, but this finding is possible because R-CBMs had a lower standard error and the concept of a true score is a hypothetical concept. Good, Simmons, and Kame’enui (2001) used regression analysis with R-CBM scores and found consistent results in that R-CBM accurately predicted other state-wide tests.

Another demonstration of the psychometric soundness of R-CBM was demonstrated by Deno (1985) when he showed that R-CBM was more sensitive to short term gains than the reading portion of the SAT. Sensitivity to short term gains is critical for a progress monitoring tool like R-CBM. Specifically, R-CBM is used repeatedly over time to detect small gains in student performance which allows for intervention effectiveness (and ineffectiveness) to be gauged early, and so that instructional planning can be guided around student responsiveness to intervention. R-CBM was demonstrated by Dunn and Eckert (2002) to be a sensitive measure regardless of whether or not the R-CBM probes were taken from grade level or above grade level difficulty. Another important feature of R-CBM is that alternate forms are readily available which allows it to be repeatedly administered with minimal likelihood of practice effects impacting assessment results. Therefore, R-CBM is a useful procedure for progress monitoring oral reading fluency.
Statement of the Problem and Purpose of the Study

Numerous reading interventions have demonstrated effectiveness for improving students’ oral reading fluency especially Repeated Reading (e.g., Eckert et al., 2002; Gilbert et al., 1996; Morgan, 1976; Samuels, 1997). Computer-based interventions may require less response effort and personnel resources than traditionally administered procedures. With computer-based procedures the scoring, graphing, and record keeping can be automated which would decrease the effort required of the teacher or interventionist. Computer-based procedures may also facilitate performance feedback to students by calculating and displaying scores immediately after each reading (e.g., the rate of correct words read per minute is automatically displayed on the screen). Therefore, computer-based procedures for reading interventions should be investigated to determine their feasibility and effectiveness in applied settings. Unfortunately, there is limited empirical evidence demonstrating effective computer-based interventions for assisting in the delivery of evidence-based reading strategies to students in need of remedial and/or intensive reading supports. The current study evaluated the effectiveness of a Repeated Reading procedure that included computer-based scoring and feedback relative to control condition that included standard reading intervention procedures.

Research Questions

1. Will Repeated Reading using an electronic recording system be as effective as traditionally administered Early Intervention Program services at increasing students’ oral reading fluency on novel generalization probes?

2. Will Repeated Reading using an electronic recording system be as effective as traditionally administered Early Intervention Program services at increasing
students’ oral reading fluency and comprehension on the Gray Oral Reading Test Fourth Edition?
CHAPTER II
METHOD

Participants and Setting

Twenty-eight elementary school students at two public schools (grades 2-5) in the rural southeastern United States participated. Random assignment to groups was not possible because of practical issues with regard to intervention implementation (e.g., interventionist’s schedule, location of schools). To address this concern, two schools of similar student populations were selected and invited to participate. These schools had similar student populations in that the schools were comprised of similar students in terms of demographic characteristics (e.g., race, SES). The two schools were then randomly assigned to be the Repeated Reading school or the control school.

Student participants were identified for inclusion in this study based on having previously presented with reading deficits. Specifically, all students who scored in the “At-risk” range on the fall administration of the Dynamic Indicators of Literacy Skills (DIBELS; Good & Kaminski, 2002) benchmark were invited to participate in the study. Parents were required to sign an informed consent form in order for their child to participate in the study (see Appendix A). Student participants were on Tier II or III of the RtI model, and at the fluency stage of reading development in that they read more than 20 WCPM with 10 or less errors on the CBM pretest (median score). Potential participants who read less than 20 WCPM or read with more than 10 errors per minute were not included because they were expected to benefit more from an intervention specifically designed to improve reading accuracy. Students who did not meet criteria for this study received remedial instruction through the three-tier process operating at their
school. The study was approved by The University of Southern Mississippi Institutional Review Board to ensure the well-being of participants (see Appendix B).

Tables 1 and 2 provide more information on the student makeup of the two schools and grade levels of the participants. A preliminary Chi Square on the race of the groups and an Analysis of Variance on reading ability was computed prior to intervention to ensure that the groups did not differ prior to intervention. The Chi Square analysis confirmed that the groups did not differ significantly \( \chi^2 (2, N = 28) = .2, p = .9 \) on race. The Analysis of Variance (ANOVA) on prior reading ability also confirmed that the groups did not differ prior to intervention on items per minute \( (F [2, 27] = .59, p = .34) \), errors \( (F [2, 27] = .62, p = .56) \), GORT fluency \( (F [2, 27] = .49, p = .51) \), or GORT comprehension \( (F [2, 27] = .59, p = .55) \). Results from the preliminary analysis of dependent measures are provided in Table 3.

Table 1

*Demographic Makeup of Schools*

<table>
<thead>
<tr>
<th></th>
<th>% of Repeated Reading School</th>
<th>% of Control School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>51</td>
<td>63</td>
</tr>
<tr>
<td>Multi racial</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Black</td>
<td>34</td>
<td>24</td>
</tr>
<tr>
<td>Hispanic</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Other Ethnicities</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Free Lunch</td>
<td>61</td>
<td>15</td>
</tr>
<tr>
<td>Reduced Lunch</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Full Price</td>
<td>27</td>
<td>78</td>
</tr>
</tbody>
</table>
Table 2

Number and Percent of Participants in Each Grade

<table>
<thead>
<tr>
<th>Grade</th>
<th>Repeated Reading</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>8 (57%)</td>
<td>8 (62%)</td>
</tr>
<tr>
<td>3</td>
<td>2 (14%)</td>
<td>1 (8%)</td>
</tr>
<tr>
<td>4</td>
<td>2 (14%)</td>
<td>3 (21%)</td>
</tr>
<tr>
<td>5</td>
<td>2 (14%)</td>
<td>1 (8%)</td>
</tr>
</tbody>
</table>

Table 3

Preliminary Analysis of Group Equality

<table>
<thead>
<tr>
<th>Pretest</th>
<th>Standard Error</th>
<th>df</th>
<th>F(Variance)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBM Fluency</td>
<td>0.83</td>
<td>27</td>
<td>0.59</td>
<td>0.34</td>
</tr>
<tr>
<td>Errors</td>
<td>0.02</td>
<td>27</td>
<td>0.62</td>
<td>0.56</td>
</tr>
<tr>
<td>GORT Fluency</td>
<td>0.68</td>
<td>27</td>
<td>0.49</td>
<td>0.51</td>
</tr>
<tr>
<td>GORT Comp</td>
<td>0.49</td>
<td>27</td>
<td>0.59</td>
<td>0.55</td>
</tr>
</tbody>
</table>

A power analysis was conducted to determine the effect sizes that could likely be detected with different sample sizes. Power was estimated by entering various effect sizes, the number of measures for each group, and the number of participants into GPower 3 (Erdfelder, Faul, & Buchner, 1996). Twenty-eight participants provided enough power to detect a large (i.e., .55) effect size with 80 percent accuracy (Cohen, 1988, p. 225). More participants were not feasible due to the time demands required to provide the Repeated Reading intervention with sufficient duration and frequency to be considered an appropriate intervention for students at increased risk for reading failure.
Over 199 participants would have been required to accurately detect a small effect size. Issues related to power will be discussed further in the Discussion section.

The study was conducted in February, March, April, and May. Pretesting occurred over a 10-day span prior to intervention. Post-testing occurred after two months of intervention. Post-testing was completed over 11 days. Testing and intervention sessions were conducted at reserved, quiet locations within the schools. At the control school, pre- and post-testing sessions were conducted in a storage room in the media center or in a corner of the assistant principal’s office. The assistant principal was not present during the sessions. The intervention sessions were conducted in a classroom reserved for the Early Intervention Program. The Repeated Reading group’s pre- and post-testing sessions occurred in a storage room in the media center. However, the Repeated Reading groups’ intervention sessions occurred at the closest quiet location to each student’s classroom to minimize time lost to transitioning and maximize time spent in instruction. These locations included a reading table in the corner of a hallway, a storage room in the media center, and a playground bench. The difference between the locations of the pre- and post-testing were minimal. However, the Early Intervention Program services were always inside but one student in the Repeated Reading group had intervention sessions at an outside bench once a week.

Materials

The reading probes that were used in the study came from the Vining-Hartness RTI Probe Book: K-5 (Vining-Hartness Company, 2007). The overall grade level of the probes was determined by the Dale-Chall formula. The intra-grade level (e.g., month within the grade) difficulty was determined by the Forecast formula (Caylor, 1973).
The Repeated Reading software that was used in this investigation was Vining-Hartness RTI Software. Vining-Hartness RTI Software Client was designed to help teachers and psychologists implement assessments and interventions by automating the data collection, scoring, and graphing of assessments and interventions typically employed under the RtI model. It has literacy, math, behavior, and mastery measurement (e.g., assessments of state content standards) modules. Only the literacy module was examined in this project. The literacy module requires that the assessments and interventions are administered by an advanced level reader (e.g., teacher) and students do not take tests independently. This is different from other programs (e.g., Accelerated Reader) where a student interacts with the computer and takes comprehension tests independently. Vining-Hartness RTI Software was designed to mimic the traditional methods of CBM and one-to-one interventions so that research on the traditional methods would generalize as much as possible to the electronic methods. Therefore, the student still reads from a paper copy of the probe. The difference between traditional Repeated Reading and using RTI Software is for the teacher who interacts with a computer instead of a sheet of paper.

To use the literacy module teachers double click the RTI Software Client icon and type the password. They select their student from a list of students registered in the program and choose what assessment and intervention they want to administer. With the electronic version, teachers indicate missed items (e.g., words), hesitations, and the last read item with an optical computer mouse, stylus, or other input device (see Appendix C).
Probes from Vining-Hartness RTI Probe Book: K-5 (2007) were used during intervention and progress monitoring. The book was originally written by college professors, elementary school teachers, counselors, and graduate students. The initial grade level of the probes was then determined by a series of readability formulas. Next, the book was reviewed by two independent viewers who modified the probes to fit within desired grade levels. Sixty to one hundred probes for each grade level were created. The book of probes was then edited five separate times by an independent review team consisting of elementary school teachers, retired elementary school teachers, and one school counselor. The independent reviewers discarded probes containing themes that they considered to be potentially inappropriate for elementary age children (e.g., one story was eliminated because it was about children who saved a beached dolphin, and there was concern that some readers could have interpreted the story as encouraging children to approach wild animals). Three elementary students and one middle student also reviewed the probes and made recommendations on what probes they liked and what probes they found uninteresting. The book was then edited by a university English professor who selected the 40 reading probes for each grade that he thought were the best, taking into account the student feedback and his professional opinion. He then edited the book, and the readability was recalculated. The grade level difficulty of the probes was then determined with the Spache formula. Next, the Forecast formula was used to estimate intra-grade level difficulty.

The Gray Oral Reading Tests, Fourth Edition (GORT-4; Wiederhold & Bryant, 2001) measures reading fluency and comprehension on passages of increasing difficulty until a basal and a ceiling have been established. The passages vary in length from 50 to
200 words with easier stories having fewer words than more difficult ones. Scores are obtained by having students orally read the passages while the examiner records errors. Once the student has read the story they are asked multiple choice comprehension questions. Students are not allowed to look back in the passage for answers to the comprehension questions. Overall, the test has a test-retest reliability index of .9 (Wiederhold & Bryant, 2001).

The criterion validity of the comprehension composite to the Woodcock-Johnson Passage Comprehension subtest is .54, the Qualitative Reading Inventory is .38, and the Peabody Individual Achievement Test is .51 (Keenan, Betjemann, & Olson, 2008). However, the oral reading fluency composite of the Gray Oral Reading Test has been found to be a more psychometrically sound measure than the comprehension composite (Keenan et al., 2008). The comprehension measure of the Gray Oral Reading Tests has the limitation of possibly being influenced by the student’s prior knowledge and reasoning skills (Keenan & Betjemann, 2006). Keenan and Betjemann asked students the comprehension questions without giving the opportunity to read the passage. Their finding was that students were able to guess the answers to the questions at better than chance accuracy without reading the passages.

Dependent Measures

The primary dependent variable was student growth on number of items read correctly per minute from pretest to protest on eight novel generalization probes from the Vining-Hartness RTI Probe Book: K-5 (2007). Correct items per minute was calculated by the software. The software calculates correct items per minute as opposed to correct words per minute because it was designed with flexibility in mind so that it could be used
to administer probes comprised of various material in addition to administering reading probes (e.g., letter identification fluency) and so that it could even be adopted to progress monitor students with special needs via user created probes. In the software, an item is defined as a block of text that is not separated by a space. Therefore, the primary dependent measure growth on Correct Items per Minute (CIPM) was equivalent to growth on the number of words read correctly per minute from pretest to posttest. This value was tabulated by subtracting each student’s median pretest score from their median posttest score for oral reading fluency on the novel generalization passages.

The second dependent variable was growth on the fluency composite of the GORT-4 from pre- to post-testing (Wiederhold & Bryant, 2001). Growth was calculated by subtracting each student’s raw score on the pretest from their raw score on the posttest. The third dependent measure was the growth on the comprehension composite of the GORT-4 from pre- to post-testing. Growth was calculated by subtracting each student’s raw score on the pretest from their raw score on the posttest. The fourth dependent measure was the change in the median number of errors from pretest to posttest on eight novel generalization probes from the Vining-Hartness RTI Probe Book: K-5 (2007). The test-retest reliability of 8 probes for elementary students is approximately .93 (Hosp & Fuchs, 2005). Errors were the number of items (i.e., words) marked as incorrect. Lower scores on this measure were indicative of better reading.

Procedures

Repeated Reading Group

The Repeated Reading group received Repeated Reading twice per week for eight weeks. The primary researcher conducted all sessions for the Repeated Reading
group. He sat down with the student and read the directions for Repeated Reading from the computer screen. He then clicked the start button when the student began reading. When the student did not begin reading within three seconds of being told to begin, then they were provided with the first word in the story and the start button was clicked.

The primary researcher corrected errors and provided the student with the word when they hesitated for 5 s. Students were allowed to hesitate for five seconds during Repeated Reading which is customary of Repeated Reading but different from the amount of time they were allowed to hesitate during curriculum-based measurements discussed later. The student was told the number of words they read correctly per minute on each reading. They were encouraged to beat their reading score. The procedure was repeated for two readings per session. Additionally, there was a fluency criterion in place in which students were required to read a passage at a rate of 100 correct items per minute before they moved on to the next passage.

**Control Group**

The control group received 35 minutes of Early Intervention Program (EIP) three times a week. The Early Intervention Program is a Georgia Department of Education initiative that provides funding to schools to target and remediate students that are behind grade level standards in academic areas. The Early Intervention Program essentially provides funding for schools to implement Tier II and Tier III services within Georgia’s four tier RTI model. Georgia Department of Education regulations require that all teachers providing EIP services are certified teachers. Schools have three options of EIP service delivery including the option of pulling the student from their reading class for 30-45 minutes for intense reading intervention which was the model employed at the
control school. The Georgia Department of Education has guidelines for the quality of training of the teachers providing services, the duration of the services, and the ratio of EIP teachers to students receiving services. However, the strategies the EIP teachers employ is at the discretion of the local educational agency. The strategies used in the Early Intervention Program at the control school were called Reading Recovery. The EIP teachers reported that Reading Recovery consisted of informal pen and paper forms of guided reading. During guided reading, the students usually practiced reading the story under the supervision of the EIP teacher. The teachers provided corrective feedback to the students and had them practice reading the stories with other adults including their parents. Details on what form of corrective feedback as well as the number of times the students read the story were not predetermined and likely varied from one session to the next. Documentation of intervention sessions and intervention protocols for the control group were unavailable. The teachers of the control group had access to database management systems where they could store and maintain intervention records, however these systems were not utilized for intervention data. One of the students in the control group did not participate in the posttests because they had left school.

*Progress Monitoring*

Students in the Repeated Reading group were progress monitored biweekly using one novel reading passage from the Vining-Hartness RTI Software Probe Book (2007) by the primary researcher. The progress monitoring was conducted at the students’ grade level using end of year passages to ensure that the progress monitoring material did not overlap with the material used for pre- and post-testing. Vining-Hartness RTI Software was used to score correct items per minute and errors. The students in the control group
were progress monitored by their early intervention program teacher using DIBELS progress monitoring probes. Progress monitoring scores were not used in the statistical analyses. However, it is important to indicate that both groups were equally exposed to progress monitoring procedures because progress monitoring includes students reading aloud for one-minute to an adult.

Interscorer Agreement and Treatment Integrity

The audio recordings of the sessions were coded by an independent scorer who held a doctoral degree in school psychology and was experienced in the proper administration of the procedures utilized in the study. The total number of agreements (correct items and errors) was divided by the total number of items in the passage (representing all of the possible agreements and disagreements). All of the pre- and post-tests (both CBM and GORT testing) were scored for interscorer agreement. Thirty percent of the intervention sessions were also scored by the independent observer. The interscorer agreement for CBM testing ranged from 95% to 100% with an average agreement of 99%. The interscorer agreement for GORT Fluency testing ranged from 94% to 100% with an average agreement of 99%. The interscorer agreement during intervention sessions ranged from 95% to 100% with an average agreement of 98%. The independent scorer also examined a copy of the electronic database and verified that Repeated Reading was conducted twice a week with the students in the Repeated Reading group. Treatment integrity was evaluated for 25% of the Repeated Reading sessions by taking the number of intervention steps correctly implemented divided by the number of items on the checklist, multiplied by 100. Treatment integrity was 99%. A copy of the treatment integrity checklist is provided in Appendix D.
Results

Table 4 shows the number of participants, means, standard deviations, and growth from pretest to posttest. Figures 1, 2, 3, and 4 show graphs of the fluency, errors, and comprehension from pretest to posttest. The Repeated Reading group read an average of 52 items per minute with an average of five errors per minute during the pretest. The control group read an average of 75 items per minute with an average of three errors per minute during the pretest. The Repeated Reading group read an average of 61 items per minute with an average of three errors per minute during the posttest. The control group read an average of 81 items per minute with an average of three errors per minute during the posttest. The Repeated Reading group had an average increase of nine items per minute and a decrease of two errors per minute. The control group had an average increase of six items per minute and had no change in the average number of errors per minute.

On the GORT-4, the Repeated Reading group scored an average of 26 for fluency and 16 for comprehension on the pretest. The control group scored an average of 38 for fluency and 21 for comprehension on the pretest. The Repeated Reading group scored an average of 35 for fluency and 23 for comprehension on the posttest. The control group scored an average of 41 for fluency and 23 for comprehension on the posttest. The Repeated Reading group improved their raw score for the fluency subtest nine points and comprehension subtest score seven points. The control group improved three points on the fluency subtest and two points on the comprehension subtest.
Table 4

Means and Standard Deviations

<table>
<thead>
<tr>
<th>Measures</th>
<th>Repeated Reading</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N = 14/14)</td>
<td>(N = 13/13)</td>
</tr>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>CBM Fluency (CIPM)</td>
<td>52</td>
<td>61</td>
</tr>
<tr>
<td>CBM Errors</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>(2.02)</td>
<td>(1.49)</td>
</tr>
<tr>
<td>GORT-4 Fluency</td>
<td>26</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>(7.68)</td>
<td>(10.22)</td>
</tr>
<tr>
<td>GORT-4 Comprehension</td>
<td>16</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>(5.12)</td>
<td>(7.05)</td>
</tr>
</tbody>
</table>

Note. *Numbers in parenthesis are standard deviations. GORT (Gray Oral Reading Tests, Fourth Edition); Comp = comprehension.

Figure 1. Reading Fluency on Curriculum-Based Measurement (Correct Items per Minute).
Figure 2. Average Number of Errors on Curriculum-Based Measurement (Correct Items per Minute).

Figure 3. GORT-4 Raw Fluency Scores.
A multivariate analysis of variance (MANOVA) procedure of SPSSPC (Version 17.0) was conducted to analyze the data (Norusis, 1988). Overall, both groups made statistically significant progress from pretest to posttest across the dependent measures irrespective of group membership. Results indicated a statistically significant within subjects effect for CIPM ($F[3, 55] = 6.36, p < .05$). The effect size for CIPM was small (partial $\eta^2 = .27$) (Cohen, 1988, p. 225). The within subjects effect for errors was ($F[3, 55] = 6.32, p < .05$). The effect size of errors was small (partial $\eta^2 = .27$). The within subjects GORT-4 fluency composite was statistically significant ($F[3, 55] = 6.29, p < .05$). The effect size for the GORT-4 fluency was small (partial $\eta^2 = .27$). The GORT-4 comprehension composite was statistically significant ($F[3, 55] = 3.46, p < .05$). The effect size of the GORT-4 comprehension was small (partial $\eta^2 = .17$). This suggested

Figure 4. GORT-4 Comprehension Raw Scores.
that scores varied significantly from pretest to posttest, but that the effect size of these measures on the dependent variables was small.

Results did not indicate a significant difference for between subjects effect for CIPM \( (F[1] = .11, p > .05) \). The between subjects effect size for CIPM was zero (partial \( \eta^2 = .00 \)). The between subjects effect for errors was not statistically significant \((F[2,55] = 6.32, p > .05)\). The between subjects effect size was small (partial \( \eta^2 = .06 \)). The between subjects effect for the GORT-4 fluency composite was not statistically significant \((F[2,55] = 6.29, p > .05)\). The effect size was small (partial \( \eta^2 = .04 \)). The between subjects effect for the GORT-4 comprehension composite was not statistically significant \((F[2,55] = 3.46, p > .05)\). The effect size for the GORT-4 comprehension composite was small (partial \( \eta^2 = .04 \)). These findings suggest that there were not significant differences between groups for the dependent measures in this study. Therefore the answer to the research questions regarding the effectiveness of Repeated Reading software in comparison to traditionally administered Early Intervention Program services is that the experimental procedure was not superior to the traditional intervention procedure.
CHAPTER III
DISCUSSION

This study examined the effectiveness of Repeated Reading using an electronic recording system. The results obtained in this investigation suggest that the answer to the first research question, “Will Repeated Reading using an electronic recording system be as effective as traditionally administered Early Intervention Program services at increasing students’ oral reading fluency on novel generalization probes?” is that Repeated Reading using an electronic recording system was not statistically different than the traditional intervention control group. With regard to the second research question, “Will Repeated Reading using an electronic recording system be as effective as traditionally administered Early Intervention Program services at increasing students’ oral reading fluency and comprehension on the Gray Oral Reading Test Fourth Edition?” there were not statistically significantly differences found between groups for reading fluency or comprehension.

The results obtained in this investigation suggest that both groups made progress from pre- to post-testing. The participants in the Repeated Reading group made more progress on average across all of the dependent measures employed in this investigation but the differences were not statistically significant. However, it is important to note that the control group entered intervention with higher scores on all measures, albeit not statistically significant higher scores, than the experimental group. As a result, one would expect greater growth from the experimental group relative to the control group due to ceiling effects.
The overall effect size for fluency in this study was smaller than the average effect size that Therrien (2004) obtained in his meta analysis. In this study the effect size for fluency was small (i.e., .27) whereas Therrien found that the average effect size of Repeated Reading interventions on novel material was large (i.e., .50). In Therrien’s analysis the Repeated Reading sessions occurred more frequently and for longer durations. Therefore, future research may replicate this study while modifying intervention such that sessions are provided more frequently to determine if results would more closely reflect those described by Therrien.

The Repeated Reading group increased their reading fluency 9 CIPM which was 3 CIPM more than the control group. This difference was not statistically significant; however, students in Tier II and Tier III typically need to make 1.5 CIPM gains per week for their response to the intervention to be considered clinically significant. Elementary aged students receiving special education services and at-risk for reading failure improve approximately one correct word per minute per week (Jenkins, Graff, & Miglioretti, 2009; Speece & Ritchey, 2005). However, students that are not at-risk for reading failure make approximately 1.5 correct words per minute gains per week. In this study the Repeated Reading group made 1.5 CIPM gains per week on average while the control group made 1 CIPM gain per week. The difference of 1.5 CIPM per week and 1 CIPM per week can be the difference between a student catching up with their peers and the student requiring more intensive supports. The Repeated Reading group’s average number of errors decreased from pre- to post testing whereas the control group had the same number of errors from pre- to post testing. However, as state previously, impressions of gains must be tempered because of the potential impact of ceiling effects.
These research findings were consistent with previous research on Repeated Reading that suggest it is an effective procedure at increasing oral reading fluency and comprehension in students who struggle with reading. The study extends the research on Repeated Reading by demonstrating that it is still effective when an electronic progress monitoring system is employed. This extension is important because Repeated Reading with electronic progress monitoring may take less time to administer, score, and provides indices of treatment integrity. Electronic Repeated Reading may also facilitate a team approach to intervention because with electronic scoring and progress monitoring everyone on the team has access to the student’s data at all times, and all of the data are integrated in one place regardless of how many different interventionists actually work with the student. It may also be easier to train people on how to conduct electronic Repeated Reading than the traditional pen and paper method. Future research is needed though to make definitive statements regarding time savings resulting from electronic scoring and progress monitoring.

Limitations

One limitation of this study was that the participants were not randomly assigned to the experimental and control groups. Random assignment to groups was not possible across schools because the district was concerned that the parents of the control group would be agitated by the fact that their child would not be getting “the high tech” intervention. Random assignment of participants to groups is one of the hallmarks of experimental research. Random assignment assists with minimizing some threats to internal validity (e.g., important differences in participants across groups). In this study,
some efforts were made to minimize participant differences across groups. However, there were still pre-treatment differences.

Another limitation of this study was the potential for experimenter expectancy effects. The Repeated Reading group received intervention from only the primary researcher whom has previous experience with Repeated Readings. Additionally, the primary researcher was aware of study conditions. Therefore, there is some potential that experimenter expectancy effects could have impacted students’ scores. However, the threat of experimenter expectancy effects was reduced by collecting interscorer agreement data for dependent measures. The independent scorer who completed interscorer agreement check was blind to the purposes of the study and the experimental conditions to which students were exposed. Moreover, interscorer agreement data indicated consistency in scoring for all dependent measures.

In Therrien’s (2004) meta analysis the most effective variations of Repeated Reading used a performance criterion for advancement to the next passage rather than a fixed number of readings. This study also used a performance criterion for advancement to the next passage if the student read 100 CIPM or more. However, if students did not meet the criterion in four consecutive sessions then they were automatically advanced to the next story. Students, therefore, read the same passage on multiple trials across sessions. The findings of this study may not apply to variations of Repeated Reading with different rules for advancement to the next passage or for terminating a session. Another limitation of the study was the location of the intervention sessions. The Early Intervention Program services were always inside in a classroom, but some of the
Repeated Reading group’s intervention sessions occurred at a hallway reading table. Also, one student’s Repeated Reading sessions occurred at a park bench outside once a week.

Another limitation of this study was that intervention implementation details for the control group beyond teacher reports that they received guided reading were unavailable. However, this study was designed to compare the experimental group to a control that received “typical” intervention services offered by schools. One might make the argument that there is great variability in the delivery of reading interventions even within single schools and school districts. As a result of limited data regarding specific intervention components used across students in the control group, little explanation can be provided regarding reasons for improved performance by control groups students and lack of difference in performance across control and experimental groups.

**Recommendations for Future Research**

As stated previously, computer-based reading procedures have become increasingly popular in schools. Unfortunately, there is limited research evaluating the effectiveness of many computer-delivered programs relative to research evaluating traditionally administered reading programs. This study included an exploratory evaluation of a Repeated Reading intervention that included computer-based scoring and progress monitoring. This study was limited by a number of methodological flaws, and as a result, future research is needed to determine if the computer-based procedures included in this study are beneficial in terms of facilitating student performance and decreasing implementation demands on educators.
APPENDIX A
CONSENT FORM

Title of Study: Effectiveness of Reading Software on Oral Reading

Study Site: Paulding County School District

Name of Researcher & University affiliation:
Seajae Hartness, B. A.
The University of Southern Mississippi

Dear Parent,

We are conducting a research study to examine whether elementary students who are behind their peers in reading will benefit more from two variations of reading practice where students reread stories multiple times orally to an advanced reader who corrects them when they make mistakes and also when the students get stuck on words they do not know. The name of the reading practice is Repeated Reading. Repeated Reading has been used in schools to help students read better since 1979 and involves reading and then rereading a story with the help of an advanced reader until the student is able to read it quickly and accurately. The methods we will use include short assessments to determine how well the student is reading, Repeated Reading and a software variation of Repeated Reading will be used by the researcher with participating students.

As a participant, your child will receive short reading assessments and Repeated Reading. The study would take place in your child's classroom during various classroom activities. Sessions will last about 15 minutes and will take place 2 - 5 times per week for the next month or two. Repeated Reading is effective and the purpose of this study is to see if a computer program makes it more effective at increasing oral reading performance. There are minimal risks involved with participation in this study outside what normally occurs in a classroom (for example, a student could be embarrassed that they are receiving one-on-one help with reading). If you decline participation for your child, it will not affect the services provided to your child at school.

Will this information be kept confidential?
Your child's name and identifying information will be kept confidential. To protect your child's privacy, he or she will be assigned a number. This number will be placed on all paper work. At no time will any paperwork contain your child's name. Please note that these records will be held by a state entity and therefore are subject to disclosure if required by law.

This project and this consent form have been reviewed by the Human Subjects Protection Review Committee, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research participant should be directed to the Chair of the Institutional Review Board, The
University of Southern Mississippi, 118 College Drive #5147, Hattiesburg, MS 39406-0001, (601) 266-6820.

What if I do not want to participate?
Please understand that your participation is voluntary, your refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled, and you may discontinue you and your child's participation at any time without penalty or loss of benefits.

What if I DO want my child to participate? If you would like your child to participate, please sign the bottom of this sheet. You may keep the second copy for your records.

________________________________
Your Child's Name

________________________________
Parent Signature ____________________
Date

________________________________
Investigator Signature ____________________
Date
APPENDIX B

INSTITUTIONAL REVIEW BOARD APPROVAL

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

Institutional Review Board

118 College Drive #5147
Hattiesburg, MS 39406-0001
Tel: 601.266.6820
Fax: 601.266.5509
www.usm.edu/irb

HUMAN SUBJECTS PROTECTION REVIEW COMMITTEE
NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Human Subjects Protection Review Committee in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 28022505
PROJECT TITLE: A Comparison of Traditional Repeated Reading to Repeated Reading Software on Oral Reading Fluency Gains
PROPOSED PROJECT DATES: 02/20/08 to 03/20/08
PROJECT TYPE: Dissertation or Thesis
PRINCIPAL INVESTIGATORS: Sejae Harness
COLLEGE/DIVISION: College of Education & Psychology
DEPARTMENT: Psychology
FUNDING AGENCY: N/A
HSPRC COMMITTEE ACTION: Expedited Review Approval
PERIOD OF APPROVAL: 05/15/08 to 05/14/09

[Signature]
Lawrence A. Hosman, Ph.D.
HSPRC Chair

[Signature]
Date 5-19-08
APPENDIX C

ELECTRONIC VERSION OF REPEATED READING (VINING-HARTNESS COMPANY, LLC, 2006)
TEACHER TREATMENT INTEGRITY CHECKLIST FOR REPEATED READING

<table>
<thead>
<tr>
<th>Participant #:</th>
<th>Date#:</th>
<th>Session#:</th>
<th>Probe#:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>TASK</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>The teacher read the following instructions verbatim: “When I say start begin reading aloud at the top of this page. Read across the page. Try to read word. If you come to a word you do not know I will help you by giving you the word. You will repeat the word and continue reading.” The teacher said “Start.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If the student hesitated on a word for more than 5 s, or said the word incorrectly, the teacher told the student the word.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total # of student errors</td>
<td></td>
<td></td>
</tr>
<tr>
<td># of errors corrected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher waited 5 s to correct the student when the student hesitated on a word.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When the student finished reading the passage, the teacher gave feedback by saying “You read ___ words per minute. This time try to beat your score.” The teacher told the student the correct score.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher said “Start.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If the student hesitated on a word for more than 5 s or said the word incorrectly, the teacher told the student the word</td>
<td></td>
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<tr>
<td>When the student finished reading the passage, the teacher gave feedback by saying “You read ___ words per minute. This time try to beat your score.” The teacher told the student the correct score.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total number of steps possible: 25+ (# of student errors) = _____

Treatment integrity: (Number of steps completed / (Total number of steps possible) x 100)
REFERENCES


Unpublished instrument.


Unpublished instrument.


