The Effects of a Computer-Assisted and Culturally Relevant Repeated Reading Intervention on the Oral Reading Fluency of First Grade English Language Learners Who Are At-Risk for Reading Failure

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Abstract

This study examined the effects of a novel computer software program, Reading RACES (Relevant and Culturally Engaging Stories), on the oral reading fluency and comprehension of urban first graders who are English language learners. The participants scored at the “at-risk” level on the DIBELS oral reading fluency middle of the year benchmark assessment. A multiple baseline across participants design was used to determine if the repeated reading strategy using culturally relevant materials delivered through the computer software would increase participant oral reading fluency and comprehension. Oral reading fluency was measured by words read correctly in one minute, and comprehension was measured by correct responses to maze passages on both culturally relevant and AIMSweb probes. Three first-grade students from a Midwestern elementary school were participants in the study.

Pre- and post-test measures were administered to all participants and consisted of two subtests for the Woodcock Reading Mastery Test – Revised, including word attack and word identification. DIBELS oral reading fluency and nonsense word fluency benchmark assessment data for the middle of the year were used to check if participants had the necessary decoding skills while being at-risk for reading fluency. During baseline, treatment and maintenance conditions, data were collected on the following dependent variables: correct words per minute (CWPM) on culturally relevant (CR)
stories, correct responses to mazes on CR stories, CWPM on novel AIMSweb passages, correct responses to mazes on AIMSweb stories, CWPM on novel CR stories, as well as how many verbal or physical prompts were necessary for the student to accurately interact with the computer program according to a procedural integrity checklist. Treatment probes were given after each story was successfully completed and generalization probes were given every three-five sessions dependent on the student reaching their goal.

Results indicate that after 7–11 weeks of intervention, the participants had increased their ORF and comprehension of novel and practiced CR passages. The intervention was also effective for increasing ORF and comprehension scores for novel AIMSweb passages, but to a lesser extent than observed for CR passages. These findings extend the research supporting the usage of Repeated readings for first grade ELL students using computer-assisted instruction to supplement reading instruction. Limitations, directions for future research, and implications for practice are also offered.

Keywords: urban learners, culturally relevant, English Language Learner, oral reading fluency, computer-assisted instruction, repeated reading
This thesis is dedicated to Erika, Elaine, and Moody- Thank you for modeling for me daily what an opportunity we have as brilliant women to make the world the place we want it to be. And for making sure I was raised to know that “Words are… our most inexhaustible source of magic. Capable of both inflicting injury, and remedying it” and helping me learn how to use those words for good.
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Fields of Study

Major Field: Educational Studies

Area of Emphasis: Special Education
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Chapter 1: A Review of the Literature

Reading is an essential skill for success in school. Yet, many children fail to become proficient readers and others struggle to read at even a basic level (National Assessments of Educational Progress; NAEP, 2013). To read at a basic level in the fourth grade, students need to achieve a score of 224; to read at a proficient level, students need to achieve a score of 250 (NAEP, 2013). As a group, fourth-grade children who have taken the NAEP exam from 1995–2013 have shown an increase in reading skills from a score of 217 to 222, remaining 28 points below proficient levels. However, at the end of this period only 35% of fourth graders in the United States read at proficient or above (NAEP, 2013). Even more troubling are the achievement gaps for urban minority populations. For example, in spite of recent increases in reading skills, with proficient being 250, Black urban learners have gone from 188 to 224 on fourth grade assessments, 26 points below proficiency. The Nation’s Report Card shows at least 50% of these students are still reading below basic and only 17% are considered proficient or above (NAEP, 2013). The data are even bleaker for children who are English language learners (ELLs) whose reading scores average 187, almost 50 points below the average score for White children. These conditions are compounded by the fact that racial minorities and ELLs are disproportionately impoverished, which means they are more likely to attend failing schools and experience reading failure (NCES, 2007). Schools are challenged to implement effective, empirically validated reading interventions that are culturally
sensitive to the literacy needs of their students. Accordingly, the current study will focus on increasing oral reading fluency using computer-assisted instruction and culturally relevant reading materials with urban first grade ELLs.

Reading Skills

It is critical that children who are at risk for reading failure are taught to read with proficiency before third grade (NCES, 2007). Moats (2007) states that “if a student hits third grade reading poorly, the chances of remediating him or her are not good” (p. 24). In order to teach children to read with proficiency, five critical components of reading, as designated by the National Reading Panel (NRP, 2000), should be explicitly taught. These skills are phonemic awareness, phonics, reading fluency, vocabulary, and reading comprehension. All of these skills build upon each other.

Phonemic awareness is the ability to manipulate the sounds in language and break a word into syllable units within words (NAEYC, 2009). Lenchner et al. (1990) compared poor decoders to above average decoders in third and fourth grade, and showed that the ability to decode pseudo words is a large part of phonological awareness. Focusing on phonemic/phonological awareness has been shown to be effective for students who are from low-income urban, culturally and linguistically diverse areas (Foorman, Fletcher, Francis, Schatschneider, & Mehta, 1998). Teaching phonemic and phonological awareness is foundational to developing students’ reading skills; however, these skills are insufficient for proficient reading without fluency, vocabulary, and comprehension (Cartledge, Yurick, Singh, Keyes, & Kourea, 2011). These five components of reading are interrelated. For example, fluency training in reading can only be effective if the child has these necessary decoding skills in his or her repertoire.
Similarly, students are less likely to comprehend text, if they are not reading fluently (Yopp & Yopp, 2009). In research, fluency has been positioned between decoding and comprehension, yet is often overlooked in practice (NAEYC, 2009). It is possible that urban minority students could improve their reading achievement with intensive focus on fluency interventions.

**Fluency**

Speece and Ritchey (2005) describe fluency as “the speed and accuracy with which text is read orally” (p. 387). Fluency is defined as reading text with speed, accuracy, and proper expression (National Institute of Child Health and Human Development, NICHHD, 2000). Speed is measured by the number of words read in a period of time (i.e., correct words per minute) and accuracy is measured by the errors that are made in that period of time.

Calculating the participant's oral reading speed during a 1-min timing is one way in which fluency can be measured (NICHHD, 2000). Calculating a student’s correct words per minute, total words per minute, and other representations of their oral reading fluency (such as marking errors, self-corrections, insertions, and omissions) can give significant insight when analyzing students’ fluency. CWPM (correct words per minute) is a calculation of total words read (TWR) minus omissions and mispronunciations. The NICHHD (2000) conducted a meta-analysis on fluency and observed that fluency depends upon well-developed word recognition skills, which depend on decoding skills and practice. The NICHHD concluded that fluency increases with reading practice and that there is a need to increase fluency. They reported, for example, “In 2000, 44% of 4th graders were found to be dysfluent at grade-level texts with a supportive reading
environment” (NICHHD, 2000, p. 3:1). Another finding in their meta-analysis was that guided repeated oral reading procedures were effective in improving reading fluency and overall reading achievement. Specifically, guided repeated oral reading procedures have been effective in increasing word recognition, fluency, and comprehension. A large body of research exists on the many variations of guided oral repeated reading procedures as an evidence-based practice to improve fluency. Some of this research is discussed below.

**Effective Practices for Teaching Fluency**

There are several effective practices that target increasing fluency skills. Interventions such as repeated reading intervention (RRI), multiple exemplar training, and error correction with word drill techniques allow the student to increase CWPM and have been rigorously researched in recent literature (Foorman et. al., 1998, Ardoin, 2008, Therrien & Kubina 2004). These fluency interventions have been studied alone (e.g., Ardoin, 2007; Baker, 2008) and in combination with other interventions (e.g., Ardoin, 2008; Begeny, 2009). Overall, this research has pointed towards the efficacy of RRI.

**Repeated Reading Intervention**

Many empirical studies have been conducted to demonstrate that RRI increases oral reading fluency (ORF) and comprehension (see Therrien, 2004; Strickland, Boon, & Spencer, 2013). RRI involves a participant having the passage verbally modeled, practicing the passage that was just modeled, and having his/her errors corrected during the intervention. Therien and Kubina (2008) recommend using a RRI intervention for students in Grades 1–3, or for older struggling readers who can properly decode. Additionally, research also supports the use of RRI strategies with learners as young as first grade. For example, Hapstak and Tracey (2007) examined the effects of assisted
RRI on four first-grade students of different reading abilities, including a participant who was an English Language Learner. This intervention included a cold read of the passage, graphing the participant’s oral reading fluency from the cold read, listening to the teacher model the passage, the student reading the passage, two 1-min timings, and then a final read with graphing of the reading fluency score. Results indicated that all students who participated in the intervention had higher oral reading fluency compared to baseline scores.

Therrien (2004), in a meta-analysis, concluded that several instructional components are effective in RRI. These components include presentation by an adult or peer, modeling to focus on speed, corrective feedback, establishing performance criteria, introducing a comprehension component, and a rewarding charting experience. One of the major discoveries that Therrien made within this analysis was “… that repeated readings may also improve students’ ability to fluently read and comprehend new passages” (p. 257). Additionally, Strickland et al. (2013) endorsed RRI for early elementary students with and without learning disabilities.

**RRI for English Language Learners**

There is a growing body of evidence for using RRI to increase ORF skills in young children both with and without disabilities; albeit, research is less abundant specifically regarding RRI used with ELLs (Fitzgerald, 1995). Nonetheless, one recent study (Kai, Heward, & Heng, 2006) selected five first-grade students who were designated by their school as ELLs. Reading materials for this study were chosen based upon the age of the reader from the daily reading materials available in the classroom. The intervention was broken into three components: vocabulary instruction, initial
untimed reading of an entire passage with error correction, and three fluency building reading trials. No modeling of the passage by the researcher occurred during the intervention. When compared to the baseline, all five participants within this multiple baseline study showed an increase in correct reading rate. Further, all five participants increased their comprehension when asked to retell the passage.

Another study by Gyovi, Cartledge, Kourea, Yurick, and Gibson (2009) looked at Early Reading Intervention (ERI) for ELLs in Kindergarten and first grade. Using a multiple baseline across subjects with 12 kindergarten and first grade students examined the effects of the ERI curriculum using a model-lead-test way for teaching. First, alphabetically based skills were presented followed by phonologically based isolations of sounds. Third was a review of the target letter and sound. Fourth was “Writers Warm-up” which included tracing the letter and then independently writing the letter while saying the song. The fifth component integrated phonological and alphabetical skills, which required the participant to match the letter with its sound. Finally, the phonological and spelling skills were combined in the final activity. DIBELS scores showed the rate of student progress and showed a functional relationship between the ERI and an increase in phoneme segmentation fluency, especially nonsense word fluency.

Although RRI has not been widely studied with ELLs specifically, existing evidence does suggest that RRI is effective for readers who are at risk in general. Further, there have been a few studies that included ELLs as participants and shown promising results. Therefore, the current study attempted to extend the current body of literature by examining the effects of RRI on ELLs.
Limitations to RRI

Kame`euni and Simmons (2001) found that although fluency is a critical component to reading and must be explicitly taught, many programs do not incorporate fluency practice. Despite the empirical evidence supporting RRI, much of this research was not conducted in applied classroom settings. Therrien and Kubina (2008) provide an eight-step sequence, which may be difficult for a teacher with limited training to implement with fidelity. Further, RRI requires one-on-one or small group instruction from a competent reader (i.e., an adult or peer), a special problem in urban settings with limited resources. In addition, teachers are not sure when or where to fit RRI into an already rigorous curriculum, and may not be sure what reading material to use when implementing RRI. For example, the Common Core mandates that teachers use on-grade level reading materials. However, students who are practicing reading fluency need to read at their instructional level (not at the frustration level), or it is possible that results will not be favorable. Selection of reading material, especially for struggling readers and readers who are linguistically and/or culturally diverse may be another reason implementation of RRI in the classroom is not widespread. All of these limitations (i.e., reading material, time, and teacher training) can be addressed by the use of culturally relevant reading materials and computer assisted instruction.

Culturally Relevant Reading Materials

Urban schools in the United States often have a diverse student population including different cultures, native languages, social-economic statuses, and races/ethnicities. The National Center for Educational Statistics has found that “Public school enrollment increased between 2001 and 2011 from 47.7 million to 49.5 million …
In addition, racial/ethnic and regional distributions of public school students have been shifting” (Racial/Ethnic Enrollment, 2014).

Culturally relevant materials are an important way to maintain and respect the many cultures of learners and motivate them to engage with materials that are culturally meaningful (Cartledge, Keesey, Bennett, Council, & Ramnath, 2015). In their review of the professional literature, Cartledge et al. found assertions that CR materials are useful in motivating and affirming learners as well as mitigating negative stereotypes. Ebe (2010) found greater reading accuracy for nine third-grade ELLs when they read stories that more closely resembled their culture compared to stories with less cultural relevance. Accuracy was measured by correct words read in the passage and their ability to retell what occurred in the passage. The students rated the passages using an informal rubric regarding CR material as a posttest. Further, Ebe proposed that CR materials are especially important for ELLs who are “not only learning to read but are also learning English… and should be provided culturally relevant texts to improve engagement and reading proficiency” (p. 209).

Ma’ayan (2010) discusses a case study of an urban fifth grade student who was at-risk for reading failure. She was a bilingual student who had been placed in special education after repeating the fourth grade. Ma’ayan used a multiple literacies approach to assess the participant’s literacy practices, it showed that in school she did not engage in most of the classroom-based literacy activities and the teacher did not look at her literacy activities outside of school. Ma’ayan recommended that the participant be given culturally relevant texts to help her engage during her time in class. She notes that during her study, participants appreciated when books represented an array of races, cultures,
and genders as the protagonists. Other recommendations included age-appropriate texts and open discussions.

There is some evidence that CR materials may facilitate fluency. Cartledge et al. (2015), for example, found that researcher-made passages, which reflected the interests and backgrounds of the targeted students, resulted in significantly higher CWPM rates for the young African American urban students. The use of meaningful text has played an important role in the RRI literature since Samuels (1979). For students who are CLD, CR material may play an important role in bridging fluency of practiced CR passages to unpracticed NCR passages. Culturally responsive materials may be of limited value if they are not at the appropriate grade level. If the material is too difficult, student may not increase in fluency and teachers may discontinue the intervention, assuming it to be ineffective. If used appropriately, CR materials may be viable means for increasing students’ understanding and willingness to practice reading behavior.

*The Role of CAI*

Time, human capital, teacher training, and treatment fidelity are other potential limitations to RRI, and potential reasons why RRI is not being used in classrooms today. All of these limitations can be addressed by CAI. CAI can help provide supplemental, one-on-one instruction, mostly independent of the teacher. In fact, recent reports supporting the efficacy of using CAI successfully to teach reading stem back to the late 1980s (e.g., Gore et al., 1989).

Similarly, in a more recent study, Hammond, Gardner, and Bennett (2012) examined the effects of Headsprout, an online phonics-based reading instruction program, for 6 kindergarten children. This multiple baseline study began with the
intervention in the computer lab with a computer that had the Headsprout program downloaded onto it. Headphones were worn, and the participants received researcher intervention if their behavior became off task or needed assistance while using the program. Students were given the direction to read the presented story to their best ability and followed the directions presented by the website (http://www.headsprout.com). Results for this study indicated that the intervention was satisfactory from perspectives of both the participants and the classroom teachers. This satisfaction stemmed from an increase on reading-related assessments and learning targets for all participants.

Second, Gibson, Cartledge, Keyes, and Yawn (2009) examined the effects of a CAI/RRI on first-grade students who were at-risk for oral reading fluency. During this multiple probe study, participants interacted with the Read Naturally technology, a CAI program requiring a laptop and headphones. Phase I included stating a goal of 40 CWPM at the end of a 1-min. timing. The treatment sessions required the researchers to observe the participant working through the software, then move them through the comprehension quiz, treatment probe, and pass timing. During Phase II the methods remained the same, however; the researcher chose a new and higher ORF goal for the practice passages. Systematic increases in CWPM were observed for all participants resulting from the CAI intervention.

One issue surrounding the use CAIs is that they can still require considerable levels of teacher monitoring, to avoid the likelihood of practicing errors while responding totally independently (Bennett, 2014; Gibson et al., 2014). Technology needs to be designed to increase errorless responding and simultaneously minimize adult supervision.
Conclusion

Reading achievement scores, particularly for urban minority students and ELLs, have been unsatisfactory for decades. RRI is an evidence-based practice that has been studies for over 30 years and, when implemented with fidelity, can improve oral reading fluency and comprehension of such students. To implement RRI with fidelity, proper reading material must be selected and an adult or peer model must be trained to work with students one-on-one for 10-15 minutes. The purpose of this study was to examine a multi-component intervention that embeds CR material within a RRI delivered on an updated version of specially created CAI that focuses on errorless learning and independence of the learner. The research questions were as follows:

1. What effect will a repeated reading intervention using culturally relevant passages delivered through computer software have on the correct words per minute (CWPM) of first-grade urban learners who are ELLs?

2. What effect will a repeated reading intervention with culturally relevant passages delivered through computer software have on the generalization of ORF to novel AIMSweb passages for first-grade urban learners who are ELLs?

3. What effect will a repeated reading intervention with culturally relevant passages delivered through computer software have on the reading comprehension of practice passages (CR) for first grade urban learners who are ELLs?

4. What effect will a repeated reading intervention with culturally relevant practiced passages delivered through computer software have on the reading comprehension of generalization passages (AIMSweb) for first grade urban learners who are ELLs?
5. What effect will a repeated reading intervention with culturally relevant passages delivered through computer software have on the maintenance of oral reading fluency on generalization passages (AIMSweb) by first grade urban learners who are ELLs after intervention?

6. What effect will a repeated reading intervention with culturally relevant passages delivered through computer software have on the maintenance of comprehension on generalization passages (AIMSweb) by first grade urban learners who are ELLs after intervention?

7. What effect will a repeated reading intervention with culturally relevant passages delivered through computer software have on the generalization of oral reading fluency on a cold read of a culturally relevant passage by first-grade urban learners who are ELLs after intervention?

8. How many verbal or physical prompts were necessary for the student to interact with the computer software correctly according to the procedural integrity checklist?

9. How many sessions did it take for the students to use the computer software independently of researcher prompts according to the procedural integrity checklists?
Chapter 2: Method

Participants and Setting

Participants for this study were recruited from an inner city elementary neighborhood school in an urban public school system located in a large Midwestern metropolitan area: Rosa Parks Elementary School\(^1\). According to the Ohio Report Card (2014), 97.4% of Rosa Parks’ population is Black/Non-Hispanic, 75.4% are students with limited English proficiency, and 100.0% are economically disadvantaged. A more in-depth look at the population indicates that 80% of the students are Somali, 18% African American, and 2% Hispanic. Rosa Parks received a “D” for overall progress, a “C” for students identified as the lowest 20% in reading and mathematics, and an “F” for lack of progress for children with disabilities as well as lack of progress for closing the achievement gap. Progress for gifted children was not rated. For the 2013-2014 academic year, the school documented 63.4% of its third grade students reading at a proficient level or higher. Rosa Parks houses two first-grade classrooms, with 52 students, and 219 students in the entire school. A total of four participants were selected for this study. Performance and demographic information can be found in Table 2.1.

Students selected for this study evidenced reading risk based on assessments on the Dynamic Indicators of Basic Early Literacy Skills NEXT edition (DIBELS; Good & Kaminsky, 2011) first grade fall benchmark assessment, and the Woodcock Reading

\(^1\) Names have been changed
Lastly, the students selected were identified as English language learners as designated by the OTELA criterion of the school district placing them between the 2nd to 4th levels of proficiency.

This study took place in the school’s library and resource room to minimize distractions. Each session included 1 to 3 participants and 1 to 3 researchers. There were 1 to 4 sessions a week with each session lasting 20 to 30 minutes. Participants were in intervention from 7 to 11 weeks. A summary of participant information including pseudonyms, age, race, gender, school, and DIBELS NEXT scores can be found in Table 2.1.

**Materials**

**Assessment Instruments**

Screening measures consisted of two sub-tests of the Woodcock Reading Mastery Test – Revised (WRMT – R): Word ID and letter ID, two subtests of the DIBELS NEXT: Nonsense Word Fluency Correct Letter Sound (NWF-CLS) and the DIBELS Oral Reading Fluency (DORF), and the OTELA for English Learners.

**WRMT-R.** The WRMT-R is a standardized reading achievement test. Word ID consists of the participants reading a list of words that increase in difficulty. The participants must pronounce and decode the words correctly in order for their answer to be considered correct. The word attack subtest consists of a list of nonsense words that the participant reads in order for the researcher to assess phonetic decoding skills. Word ID consists of the participants reading a list of words that increase in difficulty. The participants must pronounce the words correctly in order for their answer to be
considered correct. Assessment procedures prescribed by the WRMT-R authors were followed.

Reliability data for each sub-test is reported as an indicator of how reliable the scores are compared to population norms. These data are reported as median reliability coefficients (r11) and median standard errors of measurement (SEM) for selected groups (i.e., Grade 1 and Grade 3, but not Grade 2). Reliability coefficients and standard error of measurement were reported for the following sub-tests at the first-grade level for forms G and H collectively: letter-word identification r11 = 0.90 and SEM = 3.6 and word attack r11 = 0.97 and SEM = 3.5.

DIBELS NEXT. Screening measures for the DIBELS NEXT consisted of two sub-tests: NWF-CLS and DORF. DIBELS NEXT consists of formative assessments designed to measure basic early literacy skills and can be used with children in grades kindergarten-third grade. The NWF-CLS subtests measures the participant’s ability to read from left to right, and the alphabetic principle and basic phonics of kindergarten-second grade. The participant’s ability to distinguish between different letter sounds on the NWF-CLS is calculated and recorded. The DORF is used to assess a student’s oral reading fluency, calculating errors and the rate at which the student is able to read in a one-minute timing. Assessments procedures prescribed by the DIBELS NEXT authors were followed.

Reliability data for each sub-test (NWF and DORF) is reported as an indicator of how reliable the scores are compared to first grade population norms. DIBELS NEXT reliability estimates are represented for 1st grade under two different types of reliability, Alternate Form and Inter Rater Form. For Alternate Form the coefficient for NWF
segmentation is .85 (Single-Form) and .94 (Three-Form) for DORF. Inter-Rater Form reports .99 (Single-Form) and 1.00 (Three-Form) for NWF. For DORF reliability Alternate Form is the only coefficient reported, the Single-Form reports .95 and the Three-Form reports .98. Validity compared DIBELS ORF passages and performance to the National Assessment of Education Progress Oral Reading Study. For first grade, the DIBELS composite score for NWF was .82 and .83 for DORF CWPM.

**OTELA.** The development of the Ohio Test of English Language Acquisition is given by the teachers at Rose Parks elementary school to determine proficiency of students who are learning English as their second language. OTELAs look at the knowledge of English in levels 1-5, 1 being pre-functional 5 being full English proficiency. This test is designed to be fully comparable to the English Language Development Assessment (ELDA) in a standard setting process conducted by Measurement Inc.. Reliability for the subtest of reading on grades 3-5 is reported as .6-.65 dependent on the proficiency of the child. For the subtest of listening, dependent on the proficiency level for grades 3-5 range from .53-.66. For the speaking subtests the range of reliability is .62 to .74. The writing subtest for grades 3-5 ranges .37-.5 consistency, dependent on proficiency level. The validity of this test is not reported (Moore, 2008).

**Culturally Relevant Passages**

This study is a replication of a previous study (Bennett, 2014), which describes the development of the CR passages. The research team created a novel set of CR passages designed to reflect the interests and background of the target population (i.e., young urban learners who were at-risk for reading failure). The team wrote 30 first-grade
passages: 24 fictional and 6 expository, varying in length from 100 to 120 words with a grade range on the Spache Readability Index from 2.0 to 2.3. Each passage has been revised to ensure cultural authenticity, developmental and grade appropriateness, and decodability (i.e., a minimum of 70% of the words in each passage are decodable at a first-grade reading level). The passages include themes on learning, food, games, sports, animals, plants, and famous people. As part of the larger project, first-grade students (separate from those who will participate in this study) with parental permission (n=27) validated these passages through a passage equivalency (Cummings, Park, & Schaper, 2012). See Appendix A for a list of stories and their Space Readability Level.

**Maze Passages**

As part of the passage generation phase of the larger project, maze passages were created to correspond to each of the 25 CR passages. The written sequence followed for developing maze passages involved identifying a word pool that include the correct word and distracter words as the multiple choice items. Words from the word pool included words from existing leveled passages. A maze was included for every seventh or eighth word if the word was not a proper noun, an article, or one part of a compound adjective or other hyphenated word (e.g., t-shirt). For the purposes of this study, all of the distractors were the same parts of speech as the target words, and at least one of the distractors made sense in the sentence, but not according to the passage. This provided the researchers with a better indication of passage comprehension (as suggested by Parker et al., 1992). The researchers selected a fill-in-the-bubble display format for the maze. The computer automatically randomized the correct and distractor words. For an
example of a Maze graph and screen shot of the computer presenting the Maze, see Appendix B.

**Generalization Passages**

The generalization passages were taken from AIMSweb (aimsweb.pearson.com). AIMSweb is a curriculum based management (CBM) system that provides for screening and progress monitoring of basic academic (i.e., reading, language arts, math) and social skills. These passages were the as non-culturally relevant (NCR) passages because the narratives are not specific to urban settings or common themes, even though the passages do contain content of interest to this grade level. Passages were chosen based on grade level difficulty (1.7–2.3) as measured by the Spache readability formula. Eighteen kindergarten stories, six first grade stories, and three second-grade stories were used in this study. The researchers input these stories into a randomizing site creating the order in which they were presented to the student. Appendix C shows the title given by AIMSweb passage, its grade level presented by AIMSweb, and Spache Readability Level, in the order it was given to the students.

**Researcher-Developed Software**

A CAI application was used to deliver a RRI to first-graders. A Toshiba laptop computers with specialized repeated reading software loaded was used to deliver these CR passages and the intervention. A unique and important feature of the software is that it allows the teachers/researchers to add custom stories to the story bank. The program allows and prompts students to listen to a human voice model, instructs students to read with that model, and has the capability to “listen” to students as they read independently. It also has the capability to calculate total words read (TWR) on one-minute timings
based on voice recognition during these independent readings; students then verify the last word that they actually read by clicking on the word. A headset with a noise-canceling microphone was used so that participants could listen to the stories with limited distractions and the computer can create an audio-record of the students’ oral reading. Using this information, the computer generated a CWPM score and displayed it for the student. During intervention, while the participant is reading practice passages, the CAI provided assistance with unknown words (i.e., reading the word) when a student clicked on the unknown word or when there was a 3s pause in their reading.

**Definition and Measurement of Dependent Variables**

There were nine dependent variables in this study. The first was number of correct words per minute (CWPM) during CR oral reading passages read on the computer. A word was counted correct when a participant pronounced it within 3 seconds of the previous word being read. A word was counted as incorrect if the participant omitted or mispronounced the word or failed to read it within 3 seconds. Additions (i.e., adding or repeating a word) and self-corrections were not counted as errors. During the timed reading phase, the instructor or the CAI did not give corrective feedback.

The second dependent variable was the correctly selected words in the corresponding CR mazes during a 3-minute timing. The computer scored a maze comprehension item as being correct if the response given by the participant matched the key and scored incorrect if it did not match the key. Feedback was not given after a maze assessment. The computer then produced a graph of the student’s scores after each session.
The third dependent variable was CWPM on AIMSweb generalization probes. The participant was given a generalization probe after three to four successfully completed CR timed readings. If the participant took more than one session to meet their fluency goal for two consecutive practice passages, the generalization probe would be given after five CR timed readings. Generalization passages were novel passages administered without the voice model on the computer. The same rules used to determine reading accuracy for CR passages was used for the generalization passages.

The fourth dependent variable was comprehension of the generalization passage. Correct responses to maze items on the AIMSweb mazes on the computer were recorded following the generalization probe. The same rules were used for accuracy of the CR mazes. Similar to the treatment probes, generalization probes were plotted by the computer following the session they were administered.

The fifth dependent variable was the maintenance of fluency 1 week after intervention was complete. Participants’ total CWPM was recorded while reading AIMSweb oral reading passages. These data were collected using the same procedures during the generalization assessments.

The sixth dependent variable was the maintenance of comprehension 1 week after intervention was completed. Correct responses to AIMSweb mazes were measured using the same procedures used during the generalization assessments.

The seventh dependent variable was CWPM on cold reads of CR passages. CWPM on CR cold reads was plotted on a graph by the computer to measure the generalization of fluency skills to novel CR passages.
The eighth dependent variable was the user’s independence when interacting with the new computer software. After the initial training session, the researcher recorded how many verbal prompts were necessary for the student to correctly interact with the computer according to the researcher-created procedural integrity checklist. The researcher counted prompts that were used to keep the participant moving through the program separate from prompts to remain on-task.

The ninth dependent variable was number of sessions it took for the students to learn to use the software without adult assistance. This was done using a permanent product of the checklist of the student’s behavior, and how many sessions had passed before they could complete the entire sheet without assistance.

*Independent Variable*

The independent variable was the researcher-designed repeated reading application with CR passages delivered through voice-recognition software with a human voice model titled Reading RACES (Relevant and Culturally Engaging Stories). Each participant was trained to use the computer-delivered intervention independently and then received the CAI approximately three to four times per week. Each participant individually worked on a laptop. The program consisted of the following sequence:

- Setting of the ORF goal and mind growth (i.e., encouraging positive practice to promote academic performance),
- Cold read (i.e., the participant read the assigned story before intervention began, for one-minute timing),
- Practice words (i.e., words pulled from the passage were taught before intervention began),
• Read to me (i.e., the computer read to the participant),
• Read along (i.e., the participant read with the computer with computer assistance for unknown words),
• Listen to me (i.e., the participant read independently for up to three one-minute timings with computer-assistance for unknown words),
• Timed reading (i.e., one-minute fluency timing),
• Charting of ORF data,
• Maze comprehension passage, and
• Charting of maze data.

*Experimental Design and Conditions*

A concurrent multiple probe experimental design across participants during intervention was used for this study. The median CWPM score on DIBELS NEXT ORF test was used to decide tier placement for the intervention. The number of participants determined the number of tiers and the number of students in each tier. A break down of student scores, tiers, and baseline data can be found in Table 3.1. All students began baseline condition at the same time. Once baseline data were stable, the first student entered into intervention, after the first generalization probe, the students’ data were assessed to determine if there are any trends and if the data were stable. Once there was an increasing trend on the intervention passages, the next participant entered intervention, and so on. All active participants entered into intervention condition 1 to 5 weeks after the baseline condition was complete. Intervention lasted from 7 to 11 weeks dependent on when each participant entered into intervention.
Screening Measures

To begin, teachers nominated students they deemed to be struggling readers. The researchers then administered DIBELS NEXT to these students. Students who qualified with both DIBELS NEXT scores and a teacher recommendation were administered the Woodcock Reading Mastery Test – Revised (WRMT-R). Students who qualified were placed into baseline. The researcher administered WRMT-R sub-tests, Word attack and Word ID, and the DIBELS NEXT subtests of Nonsense Word Fluency Correct letter sounds and DIBELS Oral Reading Fluency to participants individually. Assessment procedures prescribed by the WRMT-R authors and DIBELS were followed precisely. Age equivalent scores and percentile ranks were derived from the raw scores for each student on all the subtests of WRMT-R. The participant’s DIBELS NEXT NWF-CLS scores had to be at or above 18 to demonstrate decoding skills. Their DORF scores had to be at or below 23 to demonstrate a risk for oral reading failure. For the WRMT-R, participants had to be at or above the 30th percentile for Word ID and Word Attack to qualify for this study (Woodcock, 1998).

Baseline

Classroom instruction included whole group instruction using a blend of phonics whole word instruction. There was no available pull-out reading intervention for struggling students offered at the elementary school. Further, there was no measurement being used to track student progress in reading. The three participants’ baseline consisted of the students reading AIMSweb passages (i.e., NCR passages used for generalization) and CR passages delivered on the computer, the number varied based upon the variability of their data. The students listened to the instructions of the computer and read the
passage using the timed reading button as the researcher followed along recording the errors on a separate sheet. The researcher collected data on the students’ errors, CWPM, and number of items score correctly on the Maze comprehension passage.

**Training**

During the session immediately preceding intervention, participants were trained on how to use the computer and Reading RACES (Relevant and Culturally Engaging Stories) software. A CR story was chosen to be used across all participants (Football in the Park). The Researcher used a training checklist to train each participant (Appendix D). The participants met the predetermined training criterion after one training session (i.e., they were able to demonstrate all the skills in the correct sequence). During this training, the student did not have to meet any fluency goals.

**Setting of the Goal**

Each participant was shown his or her baseline data (presented as a graph on the computer) and a goal (i.e., 20 CWPM, 25 CWPM, or 40 CWPM) before the Computer Assisted Instruction (CAI) session began. The participant was prompted to put the headphones on and log into the computer by finding his/her initials. The computer then reviewed the previous day’s data and had the student adjust to the appropriate goal. According to DIBELS the oral reading fluency at which participants (i.e., first graders) are expected to read is 23+ CWPM by the middle of the year and 47+ by the end of the year. The researcher set the participant’s goal in the computer to an interval of 5, beginning from 20. The goals were slightly higher than the benchmark goals set by DIBELS NEXT to encourage transfer of ORF skills to generalization passages (i.e., AIMSweb). To choose the goal, the student’s goal was set at 20 if the median baseline
was below 20, or the nearest interval if baseline was above 20. If the participant’s goal was between 20 and 40 CWPM the computer played the voice model for 40, if the participant’s goal was between 45 and 60 CWPM the voice model played at 60 WPM, if the participant read above 60 the computer provided the model at 90 WPM.

The researcher prompted the participant to listen to the introduction. The computer read the same directions to each participant at the beginning of each session. After the introduction, the computer prompted the student to click on “Yes” if he/she was ready to begin the intervention session. Next, the computer prompted the participant to find his/her name in the drop down menu labeled “Student Name.” The computer then prompted the student to click on the “Listen” button where the computer explained the sequence of the intervention. After the computer explained the sequence of the intervention, participants were prompted to click on “Yes” if they were ready to begin or “Listen Again” to hear the instructions again. Following these instructions, the computer presented a graph of their work over the last sessions, prompting them to try to reach their goal again.

Then, the computer prompted the participant to find the assigned story for that day in the dropdown menu and cold on the “Begin” button to start with a cold read of the assigned story. The 25 CR passages were divided into five sets of five stories. Each story set was randomly assigned to students and they progressed through the stories in the set. The researcher prompted the student to select the chosen story from the day from the dropdown menu. There was one expository text in each set, except one; the remaining passages were fictional.

**Cold Read**
Once the participant selected the correct story and clicked the “Begin” button the computer read the following directions. “First let’s see how well you can read this story for a minute. Remember to do your best and a smoothest reading. Start reading as soon as I say, ‘GO!’ When you are ready, click on ‘OK.’” After the computer read the directions to the participant, he/she read the selected story for one minute. After one minute a timer rang and the computer prompted the student to click on the last word he/she read. The computer then told the participant how many words he/she read. If the participant met or exceeded the goal, the computer read, for example, “Congratulations! You read 43 words per minute. Your goal is 40 words per minute. You reached your goal without even practicing! Click on the ‘OK’ button.” The participant was then prompted to click on the Timed Reading button. If the participant read less than his/her targeted goal, the computer read “Very nice! You read _____ words per minute. Your goal is ____. With a little practice I know you can reach your goal. Click on the ‘OK’ button.”

**Practice Words**

After the participant read the story for one minute during the cold read, the participant went through prescribed practice words with the computer. The computer showed the student a word (i.e., football), and say “This word is ___________. Say __________.” The computer then waited for the student to successfully say the word, if the computer did not recognize they had said the word, they could click skip. After this occurred, the student was shown a sentence with the word in it and the computer said, “Read this sentence.” After this sequence was completed for the story (3-4 words for each story) the computer moved to Read to Me.

**Read to Me**
During the Read to Me session the computer read the following directions to the participant “Now you will listen as the story is read. Follow along as the words are highlighted in blue.” After he/she clicked “OK,” the computer played the pre-recorded human voice model for the assigned story at the participant’s goal speed (i.e. 40, or 60 CWPM). The blue-highlighting feature kept pace with the voice recording. The participant may have been prompted by the researcher to follow along with the story if their attention appeared to be fading.

**Read Along**

After the story was complete, the computer prompted the participant to select the “Read Along” button. Just as in the “Read to Me” condition, the computer read the following directions. “Now you will read along as the story is read. Make sure to read loud and clear into the microphone. If you need help, you can click on the word and I’ll stop and say the word. Then we will begin again from the beginning of the sentence. After I read the title you can begin.” When the participant clicked on a word they needed help with, the computer said the word then began again from the beginning of the sentence. After the participant clicked “OK,” the computer played the pre-recorded human voice recording for that particular story at the participant’s goal speed (i.e., 40 or 60 CWPM).

**Listen to Me**

After the participant finished reading with the computer, the computer prompted the participant to select the “Listen to me” button. During this phase of intervention, the computer read the following directions to the participant.
“Now you will read alone for one-minute. Your goal is 40 words per minute. I know this is high, but you have been practicing, and I know you can do it. If you have trouble, I will help you to reach your goal. Please make sure you say every word clearly so we can hear all the words you say. Do your best and smoothest reading; if you get stuck on a word try to sound it out; if you are really stuck, click on the word and I will help you. At the end of the minute, we will practice any sentences that you had trouble reading. We may do a total of 3 one-minute timings.”

The participants had a chance to practice three one-minute timings, trying to reach their set criterion with 90% accuracy. Just as in “Read Along” if a participant did not know a word, he/she was prompted to click on the word and the computer provided that word. At the end of the 1-min. timing, the computer told the participant to click on the last word that he/she read. The computer then displayed the CWPM to the participant. If the participant did not reach his/her goal the computer highlighted the word that the participant needed to read to reach his/her goal. The computer then prompted the participant to click on “Listen to me” again. If the participant did reach his/her goal and read the passage with 90% accuracy, after clicking on the last word read, the computer prompted the participant to click on “Timed Reading.”

If a participant did not qualify for the timed reading after three “Listen to Me” trials, the session ended and the participant started the “Listen to Me” phase over with the same story the next session. If a participant did not reach his/her goal after two days, the goal was systematically lowered for the third day. In this case, the goal was re-set to a criterion that was more attainable for the participant. To systematically lower a participant’s goal, researchers sliced back the goal by 5 CWPM. For example, if a
student’s goal was 30, his/her goal was sliced back to 25. Once the student reached the new goal, the goal was raised to the previous level (e.g., 30) the next session.

If there was an announcement or other noise disturbance during the reading, the student hit the stop reading button, waited for the noise to pass, and re-started the timing they were on (i.e., RTM 1, 2, 3). This was noted on the researcher data sheet.

**Timed Reading**

The “Timed Reading” was also known as the treatment probe. During this phase, the computer gave the participant one-minute to read the practiced passage and did not provide corrective feedback (i.e., participants were not be able to click on unknown words or told a word after a 3-second pause). The following directions were displayed and read to the participant.

“Now let’s see if you can meet your goal on one more one-minute timing. Your goal is 40 words per minute. Remember to do your best and smoothest reading; Remember to start reading as soon as I say, “GO!” When you are ready, click on ‘OK.’”

If the participant reached his/her goal the computer read, “Congratulations! Your goal was 40. You read 60 words per minute! Now, you can click on the Maze button.” If the participant did not reach his/her goal the first time, the computer read, “Your goal was 40. You read 25 words per minute. Let’s try another timed reading and see if you can meet your goal.” If the participant did not reach his/her goal after the second Timed Reading the computer read, “Your goal was 40. You read 22 words per minute. You tried your best today, but let’s take a break. We can practice this again next time.”

The researcher recorded errors made during the reading using a paper/pencil data sheet (see Appendix E) to calculate the errors and CWPM to verify the computer’s
calculation. The participant was required to reach the specified goal on this timing to move on to the comprehension maze passage. If the participant did not meet his/her goal during this 1-min timing, he/she was given a second chance to read it again. In total (including the read along, listen to me, and timed reading phases of the intervention) the participants had the opportunity to read the same story 5-8 times per session. The maximum number of times that one participant stayed on one story was three sessions (i.e., a participant practiced the same story no more than three days). Appendix F gives a screen shot of a story as read on the computer.

As mentioned above, if there was an announcement or other noise disturbance during the reading, the student hit the stop reading button, waited for the noise to pass, and re-started the timing they were on (i.e., TR 1, 2). This was noted on the researcher data sheet.

Maze

After the participant met his/her goal during the Timed Reading, the computer prompted the participant to select the “Maze Comprehension” button. The participant was given directions and the computer timed the student for 3-minutes. The mazes tested participant comprehension on the passage that he/she read at or above the goal. There were approximately 11 to 15 response opportunities for each maze passage. Participants had three fill-in-the-bubble choices on the computer. The data taken by the computer served as a permanent product and the computer calculated the correct score. Mazes were only taken one time and the computer then plotted the correct raw scores on a graph.

Generalization Probe
After a participant met his/her goals on three consecutive CR stories or every 5 sessions if their goal was not met, the participant read a generalization probe. The number of errors and correct words read per minute were computed as generalization probes. After the participant completed the 1 minute timing on the AIMSweb (i.e., NCR) passage, regardless of the CWPM read, he or she was given a corresponding AIMSweb comprehension maze passage.

**Maintenance**

One week after intervention ended, the researcher asked each participant to complete one novel CR passage and one AIMSweb passage on the computer. This phase was identical to baseline with the exception that only one story was read. As in baseline, errors made, CWPM, and items scored correct on the maze passage were graphed on the computer.

**Behavior Management**

A participant’s behavior was reinforced in many different ways. First, the computer displayed the results of the TWR and CWPM, which were used as a visual reinforcer. Second, the participants saw their charts where they plotted their progress on both treatment and generalization probes across sessions, allowing them to see their progress and work. In addition to plotting their progress, when a student completed a story, they were able to cover the story in their folder with a sticker. After each session during baseline and pre-testing, participants were given the opportunity to select a preference tattoo (i.e., Monsters Inc. or Frozen) as a small reward for trying their best. In addition to a sticker, two students expressed interest in telling their teacher how many words they had read; therefore, this became a reinforcer for them as well.
Social Validity

Participants were given an interview questionnaire after intervention ended to examine their thoughts on Reading RACES and their perceived progress. For examples of this questionnaire, see Appendix H.

Treatment Integrity

The purpose of collecting treatment integrity during these studies was three-fold. The performances of the primary experimenter, the participants, and the computer were all observed. In all instances, checklists were used to calculate the percentage of steps completed correctly.

Primary Experimenter

Treatment integrity was calculated for 51.1% of each phase of intervention. Phase-specific checklists were used to calculate total percentages of steps completed (Appendix I).

Computer

The software was still in the developmental stage; therefore, as the computer delivered the intervention, the primary experimenter used a checklist to assess treatment integrity at least 100% of the time. A second observer was present and used the same checklist during 51.1% of the sessions (Appendix J).

Participants

As participants progressed through the intervention, the primary experimenters used a checklist to ensure the computer and participants were operating the computer with fidelity across 100% of the sessions. A second observer used the same checklist to
observe the participant and computer during 51.1% of the sessions. IOA was then calculated between the primary and secondary experimenters (see Appendix L).
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Table 2.1. Participant Information

<sup>a</sup> Age: refers to the age of each participant in years and months at the time DIBLES Next Middle of the Year (MOY) sub-tests were administered (01/21/2015)

<sup>b</sup> Race: refers to the racial background of each participant

<sup>c</sup> PR: refers to the percentile rank of the student taking into account their age and raw score
Chapter 3: Results

This section will present the results for interobserver agreement (IOA), treatment integrity, social validity, and participants’ reading growth measures. Further, a breakdown of each participant’s correct words per minute (CWPM), correct maze responses for both CR and AIMSweb passages, and independence data are reported.

Interobserver Agreement

Primary experimenter. Two graduate students (one doctoral student and one master’s student) and one research assistant (early childhood undergraduate student) were trained to serve as both a primary experimenter and second observer. This training required the experimenter to achieve 90% procedural integrity and 90% IOA for each timing before he/she was able to conduct or observe participants for this study. IOA was calculated for each timing for each student using exact agreement. Specifically, agreements were divided by the number of agreements plus disagreements, multiplied by 100, and rounded to the nearest tenth, to calculate the percent agreement. Each participant was observed by a second observer for 50% of each subtest during pre- and post-tests, 58.5% of baseline AIMSweb and CR passage assessments, 51% of intervention sessions, 46.7% of treatment probes, and 100% of generalization probes.

Aggregated IOA calculations for the three participants for each phase of the intervention are as follows. The IOA for the WRMT-R pre and post was a mean
agreement of 95.3% (range: 86.6%-100%); data were collected on 100% of the subtests.
During baseline on both the AIMSweb and CR passages, there was a mean agreement of
97.6% (range: 86.8%-100%). IOA was collected across 58.5% of baseline sessions.
During intervention, 51% of sessions had a second observer and the mean agreement of
98.3% (range: 81.0%-100%). For the maintenance probes (CR passages), 100% of the
sessions had a second observer and the mean agreement was 99.0% (range: 97.1%-100%). For the generalization probes (AIMSweb passages), 100% of the sessions had a
second observer and the mean agreement was 99.0% (97.1%-100%).

**Computer.** IOA was calculated for 51.1% of the “listen to me” 1-minute timings for each
participant during the intervention phase to check the computer’s accuracy on total words
read (TWR). Each of the 25 stories was checked for IOA at least once across the 3
participants. There was 100% agreement between the computer and the primary
experimenter.

*Treatment Integrity*

**Participants.** As the students interacted with the computer software during intervention,
the primary experimenter used a checklist (see Appendix J) to assess treatment integrity
across 100% of the sessions. A second observer used the same checklist to observe the
participant’s interaction fidelity over 51.1% of the sessions. IOA was then calculated
between the primary and secondary experimenters. The aggregated means reveal that
participants followed 94.8% of the directions given by the computer (individual
participants’ mean scores ranged from 92%-98%). The mean agreement between
primary and secondary experimenters was 99% (with a range between participants of
98%-100%).
Social Validity

After each participant completed the 1-week maintenance probe, the researcher asked a set of social validity questions (Appendix G). In general, all the participants said they enjoyed reading on the computer, that they thought their reading had improved, and liked seeing their progress on the computer generated chart. Two of the three students stated that they would like to continue reading on the computer next year. All three stated that they enjoyed reading on the computer. When prompted why, one student answered the “stories are interesting,” and another stated it “is fun.” To conclude the questionnaire, the researcher presented each participant with his or her chart of stories that had been read and asked the title of his/her favorite and least favorite story. This information, as well as their other answers to the social validity questionnaire can be found under each participant’s subheading.

Reading Growth Measures

DIBELS. Two DIBELS benchmark assessments were given to the participants throughout the year, the results are shown in Table 3.1. The researchers administered the middle of the year (MOY) benchmark assessment for nonsense word fluency (NWF) and DIBELS Oral Reading Fluency (DORF) in January. These data were used to screen students for eligibility for the study. During the 1-week maintenance probes in May, the researcher administered the end of the year (EOY) assessments. Overall, only one participant (Isabelle) moved from at-risk (18) to at-benchmark (49). One participant doubled his DORF score from 6 to 12, but remained at-risk for reading failure. And one increased from 10 CWPM to 35 CWPM, which is approaching benchmark but still placed her in the at-risk category.
Oral Reading Fluency and Maze Results

Individual results on mean scores and percentage growth for CWPM and Maze responses on both CR and AIMSweb passages are reported in Figure 3.1.

**Nico**

**CR CWPM.** Nico’s data for the CWPM on CR passages show that when Nico read novel CR passages on the computer with no practice during baseline, his mean score was 9 (range: 6-10). When Nico entered intervention, his goal was 20 CWPM, in the first five sessions Nico’s scores ranged from 29 to 41 CWPM. He read 23 stories over the course of 28 sessions (Nico repeated 5 stories in order to reach his goal) and had a mean intervention score on CR passages of 18.1 (range: 29-72). Nico increased his goal from 20 to 55 over his 28 sessions and made 101% percentage growth from his CR baseline scores (Figure 3.1). One week after intervention, Nico was administered a cold read of a novel CR passage, he scored 24 CWPM (Table 3.1).

**Listen to me.** Nico practiced a total of 24 CR stories over 28 sessions. The first story was a training story (“Football in the park”) and the 25th was retained for the maintenance probe. He was able to meet his CWPM goal on 18 of the stories during a single session and five of the stories in two sessions. Nico had a total of 28 intervention sessions over the course of 11 weeks.

**CR Maze.** Nico’s data for the maze responses on CR passages showed that when he read novel CR passages on the computer with no intervention, his mean comprehension score was 1 (range: 0-2). After intervention, Nico’s first five CR maze scores ranged from 2 – 8, showing an almost immediate effect on his scores (Figure 3.2). His mean number of responses after intervention was 7.6 (range: 2-11). Nico had a 661% positive percentage
growth from his baseline maze scores. One week after intervention Nico scored a 4 on the maze, which similar to baseline conditions, he did not receive intervention before taking.

**AIMSweb CWPM.** Nico’s data for the CWPM on AIMSweb passages show that when he read novel passages on the computer during baseline his mean fluency score was 7 CWPM (range: 4-9). On novel AIMSweb passages during intervention, Nico read a mean of 17.33 CWPM (range: 6-25). This was 148% positive percentage growth from his baseline score. On the first probe after practicing 4 stories in 5 sessions, Nico scored 6 CWPM on a novel AIMSweb passage. One week after intervention, he was given a novel AIMSweb passage, Nico scored 24 CWPM.

**AIMSweb Maze.** Nico’s data for the maze responses (Figure 3.2) on AIMSweb passages show that when he read novel AIMSweb passages during baseline, his mean comprehension score on the maze passages was 1 (range: 0-2). Nico’s scores on the maze comprehension questions increased to 6 on the first passage following intervention. His mean score for his probes during intervention was 4.3 correct responses. This was a 333% percentage growth from baseline correct responses. One week after intervention ended Nico was given a novel AIMSweb passage and completed the corresponding maze, he scored 6 correct responses. Nico’s overall fluency and comprehension increased on both CR and AIMSweb passages.

**Social Validity.** Nico’s favorite story was *Grandpa’s Sweet Potato Pie*, which he had placed his favorite color sticker on, he stated “it was easy” though it took him two days to complete. His least favorite story was *Ben Carson* because he didn't remember it. In
general, Nico said he liked reading on the computer because “it was fun” and thought he had gotten better at reading on the computer.

**Treatment Integrity and Independence data.** Nico followed the procedural checklist (i.e., the computer’s directions) with a mean of 94.4% fidelity (range: 70-100%). IOA agreement on Nico’s fidelity occurred 53.3% of the time with a mean of 99% agreement between observers. During the first five intervention sessions, Nico required a mean of 6 task prompts to get through the intervention successfully. These prompts included redirecting to the program, raising his hand when graphs were shown, and reading along with the computer. After the first five intervention sessions, Nico’s prompting requirement decreased to a mean of 2.5 task prompts per session for the remainder of the sessions (Figure 3.3).

*Arya*

**CR CWPM.** Arya’s data for the CWPM on CR passages when she read novel passages on the computer with no practice during baseline revealed her mean fluency score was 15 CWPM (range: 7-25). Immediately after intervention started her CWPM score improved to 58 after a training story. Her mean for intervention CWPM was 24.8 (range: 32-79), which was a 65% percentage growth from baseline. Arya’s goal started at 25 and she was able to increase her goal to 60 CWPM (Figure 3.1). Arya read 22 stories in 31 sessions; she repeated six stories, one of which was read over three sessions to reach her goal. One week after intervention stopped, Arya’s score on a novel CR passage was 32 CWPM, which doubled her score from baseline.

**Listen to me.** Arya practiced a total of 22 of the 25 stories over 31 sessions. The first story was used as a training story, the 24th story was not completed due to time
constraints, and the 25th was retained for use as generalization probe. She was able to meet her goal on the first session for 18 of the stories, two tries for 5 of the stories, and three times for 1 of the stories. Arya had a total of 32 intervention sessions over the course of 10 weeks.

**CR Maze.** Arya’s data for maze responses on CR passages show that when she read novel CR passages on the computer with no practice during baseline, her mean comprehension score on the maze passages was 3.8 (range: 2-4). Immediately after intervention started her maze score increased to 7, with an intervention mean of 8.8 correct responses (range: 6-12). This was a 133.7% positive growth on correct responses from baseline. One week after intervention stopped, Arya was given a maze corresponding with the cold read of the CR passage she had read, intervention was not given for this component and the student scored 5 correct responses.

**AIMSweb CWPM.** During baseline Arya scored a mean of 18.7 CWPM during her AIMSweb probes (range: 14-29). On her first generalization probe Arya scored 24 CWPM which showed an increase of six CWPM from baseline after five intervention sessions. The mean score for generalization probes during intervention was 25.2 CWPM which showed a 35% percentage growth. One week after intervention ended Arya was given a generalization probe, she scored 32 CWPM indicating she had almost doubled her baseline fluency score.

**AIMSweb maze.** Arya’s maze response data on AIMSweb passages show that when she read novel AIMSweb passages during baseline, her mean comprehension score on the maze passages was 2.7 correct responses (range: 2-4). Arya’s scores on the maze comprehension questions increased by the first generalization probe, where she answered
5 correct. During intervention, the mean number of correct responses for generalization probes was 6.17, a 127% percentage growth from her baseline correct response scores (range: 5-9). One week after intervention ended, Arya answered 6 Maze responses. Arya’s overall fluency and comprehension did not seem to increase quickly but did make gains.

Social Validity. Arya’s favorite part about reading on the computer was the stories; she enjoyed Party for Sister most. Her least favorite story was Artist Laquita but could not remember why. Arya said that she would like to continue reading on the computer because “I like to see my grades,” referring to the computer generated graph at the end of each session. Further, Arya stated that her peers would probably like to read on the computer because “they like stories” and “it’s fun reading.”

Treatment Integrity and Independence Data. Arya followed the procedural checklist (i.e., the computer’s directions) with 98% accuracy (Figure 3.3). The most common component that Arya missed was remembering to raise her hand whenever she saw a chart, this was the only non-computer prompted component. A second observer collected IOA data on 53.1% of Arya’s sessions and had 100% agreement over sessions. In the first five intervention sessions, Arya averaged 2.6 task prompts to complete the program correctly. After the first five intervention sessions, Arya averaged 1 task prompt per session, and it was to raise her hand when she saw a chart.

Isabelle

CR CWPM. Isabelle’s data for the CWPM on CR passages show that when she read novel CR passages on the computer with no practice during baseline, her mean fluency score was 21.7 CWPM (range: 9-26). During her training session Isabelle’s CWPM
score increased to 55 on her Timed Reading score. Her goal began at 25 CWPM and she increased to 65 CWPM in 8 sessions where she did not reach her goal on the first try. Isabelle finished with a goal of 75 CWPM, her mean score for the CR cold reads was 41.6 CWPM (range: 28-58) which was a 92% growth from her baseline mean score. Isabelle was given a novel CR passage one week after intervention had stopped, she scored 50 CWPM, more than double her baseline score.

*Listen to me.* Isabelle read a total of 19 stories out of 25 available due to time constraints of the school and availability of the computer software. In addition, the first story was used as a training story and the 25th was used as the maintenance probe. Isabelle received 25 intervention sessions and was able to reach her goal on the first session for 14 of the stories and five stories took Isabelle two sessions to reach her goal. She required very little prompting to get through the program but was frequently asked to speak up as she spoke very quietly and it was difficult for the researchers and the computer to hear her. Isabelle had 25 intervention sessions over the course of 7 weeks.

**CR Maze.** Isabelle’s data for maze responses on CR passages show that when she read novel CR passages on the computer with no practice during baseline, her mean comprehension score on the maze passages was 2.8 correct responses (range: 2-4). During her training story, Isabelle reached the ceiling of 16 correct responses. During each of the following intervention stories, Isabelle finished the maze between 2:00 – 2:30 minutes. The mean number of correct responses during intervention for practiced CR stories was 12.8 (range: 10-15). This was a growth of 365%. One week after intervention had stopped, Isabelle was given a novel CR treatment probe and scored 9 correct responses without intervention on the story.
**AIMSweb CWPM.** Isabelle’s data for the CWPM on AIMSweb passages show that when she read novel passages on the computer during baseline, her mean fluency score was 25.4 CWPM (range: 13-43). Because she had such a variable AIMSweb baseline and short time in intervention, Isabelle’s generalization did not show up until session 47 where she scored 53 CWPM on an AIMSweb passage. During intervention Isabelle scored a mean of 43.4 CWPM on AIMSweb probes, which was a 71% positive percentage growth from her baseline data. One week after intervention was stopped, Isabelle was given a novel AIMSweb passage to read on the computer, she scored 50 CWPM doubling her baseline mean score.

**AIMSweb Maze.** Isabelle’s data for the maze responses on AIMSweb passages show that when she read novel AIMSweb passages during baseline, her mean comprehension score on the maze passages was 4.8 correct responses (range: 1-8). After intervention began, her mean comprehension score on the AIMSweb maze passages was 12.4 correct responses (range: 9-16) which was a 157% positive growth compared to her baseline scores. One week after intervention had stopped, Isabelle was given an AIMSweb passage with a corresponding Maze, she scored 9 correct responses, almost double her baseline mean.

**Social validity.** When asked which story was her favorite, Isabelle replied, “*New Student* because I am a new student!”, this story took only one session for Isabelle to meet her goal on. Her least favorite story was *Snow Angels*, when asked why she answered, “because when it snows it is cold, and I don't like cold.” Overall, Isabelle stated that she enjoyed reading on the computer because “I like the headphones” and “because I got a lot of stickers.” However, when asked if she would like to continue reading on the computer
she answered “No, because my voice is too little” in reference to the computer asking her to read louder.

**Treatment Integrity and Independence Data.** Isabelle followed the procedural checklist (i.e., the computer’s directions) for an average of 92% of the directions given (Figure 3.3). Like Arya, Isabelle’s only task prompt she needed was to raise her hand after a graph was shown on the computer. A second observer performed IOA on 44% of Isabelle’s session and had agreement with the primary observer an average of 98% across sessions. During the first five sessions, Isabelle required an average of 1.6 task prompts to successfully complete the program according to the checklist. After the first five sessions, Isabelle required 0.7 task prompts to complete the program.
<table>
<thead>
<tr>
<th>Participant</th>
<th>Average AIMSweb CWPM</th>
<th>Average CR CWPM</th>
<th>Average AIMSweb Maze</th>
<th>Average CR Maze</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Intervention (% growth)</td>
<td>Baseline</td>
<td>Intervention (% growth)</td>
</tr>
<tr>
<td>Nico</td>
<td>7.0</td>
<td>17.3 (148%)</td>
<td>9.0</td>
<td>18.1 (101%)</td>
</tr>
<tr>
<td>Arya</td>
<td>18.7</td>
<td>25.2 (35%)</td>
<td>15.0</td>
<td>24.8 (65%)</td>
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<tr>
<td>Isabelle</td>
<td>25.4</td>
<td>43.4 (71%)</td>
<td>21.7</td>
<td>41.6 (92%)</td>
</tr>
</tbody>
</table>

Table 3.1 Baseline and Post Intervention Scores

Baseline and post intervention scores by mean on CR and AIMSweb passages for CWPM and correct responses on maze passages, and percentage growth for both measures.
Figure 3.1. CWPM across participants
The dashed line represents an average of the participant’s scores on practiced passages during the Timed Reading step of intervention.
Figure 3.2 Correct Responses on Maze comprehension passages
Figure 3.3 Task Prompt data
Chapter 4: Discussion

This chapter discusses the results of the study organized by each research question. Each question is answered from analysis of the data collected. Also included is anecdotal information for each participant, limitations of this study, suggestions for future research, and practical implications of this study.

This study was one in a series of field tests to examine the effects of a multi-component, supplemental intervention (i.e., RRI and CR material) engineered into a novel CAI software program (see Bennett, 2014). This novel CAI software, titled Reading RACES, was used in a multiple baseline probe across participants design to demonstrate experimental control. This was designed to help increase instructional efficiency, which is essential in helping at-risk readers make the large gains needed to catch up with their peers. The following questions were addressed:

What effect will a repeated reading intervention (RRI) using culturally relevant (CR) passages delivered through computer software have on the correct words per minute (CWPM) of first-grade urban learners who are ELLs?

There was a functional relationship between the CAI program using CR passages paired with RRI and ORF growth on practiced passages across the three participants. Figure 3.1 shows that all participants quickly responded to intervention and reached their fluency criterion when practicing CR passages. When targeting ORF skills, these results
indicate that explicit instruction is effective in helping students with risk read higher rates on practiced passages. When students were able to reach their goal consistently, their goals were increased (e.g., from 20 to 25). This led to immediate gains, as seen with Isabelle when her goal was increased to 60 CWPM and remained there or above for the duration of her intervention sessions. Further, although the gains of the Tier 1 participant look small, Nico was able to double his CWPM on cold reads from his baseline average to his intervention average.

For some stories, participants did not reach their goal on session one, and could take two or three days to get through the intervention successfully. Nearly half (42%) of these sessions took place the session after the student’s goal was increased by 5 CWPM. Arya had one story that took her three sessions to complete, and her goal was reduced to 45 before she was able to reach it. This reduction, combined with the rest of her TR scores, led to her goal being stagnant at 45 CWPM over 10 sessions, and slow ORF progress. With more time and available stories on the computer, increasing Arya’s goal more quickly may have better illustrated the findings of Kostewicz and Kubina (2011) who found that increasing a student’s goal more quickly can increase their oral reading fluency over time. This was shown when participants whose goal increased more quickly, like Isabelle, made greater changes in their practiced CWPM scores before hitting her final goal of 75 CWPM.

*What effect will a RRI with CR passages delivered through computer software have on the generalization of ORF to novel AIMSweb passages for first-grade urban learners who are ELLs?*
Figure 3.1 shows that by the end of intervention all three participants had made fluency gains on novel AIMSweb generalization passages. For two of the participants (Nico and Isabelle) generalization was apparent after 3 sessions. Arya made slower fluency gains, taking five sessions which was consistent with her slower ORF gains. The generalization data are consistent with the findings of Bennett (Under Review) who also found students varied in the speed at which they generalized their intervention skills to novel AIMSweb passages. The fluency goals set for these participants were designed to close the gap between learners with risk and their benchmark level peers (Gibson et al., 2009). And although only one participant (Isabelle) met benchmark during the DIBELS EOY testing, each participant increased his/her ORF substantially on novel passages during intervention. With additional time and stories on the computer, the participants in intervention would likely demonstrate even more growth.

*What effect will a RRI with CR passages delivered through computer software have on the reading comprehension of practice passages (CR) for first grade urban learners who are ELLs?*

CR stories and Maze passages were delivered on the computer, and students were able to click on the word they thought best fit in the sentence. Figure 3.2 shows that all participants showed great improvement on CR mazes when compared to baseline correct responses. After intervention, one participant (Isabelle) finished each of the Mazes before the timer finished, and would have had higher scores if there were more opportunities available. Isabelle’s data indicate that reading with a higher fluency rate may have enabled students to read the options more quickly, allowing them more chances to respond correctly to the multiple guess options. Another change from baseline would
be that the students practiced the story several times during intervention, which may have contributed to this improvement.

*What effect will a RRI with CR practiced passages delivered through computer software have on the reading comprehension of generalization passages (AIMSweb) for first grade urban learners who are ELLs?*

All three participants experienced increased correct responses on novel AIMSweb passages. Figure 3.2 shows that the trends for AIMSweb mazes followed a similar trend for the participant’s CR mazes, but a smaller degree of improvement was seen. This could be indicative that the CR intervention allowed the student more exposure to the text than the novel AIMSweb passage, which led to the student being more familiar with the correct options on CR mazes. Given that reading’s main purpose is for the student to comprehend the information, this data is encouraging and extends the work of Fuchs et al. (2001) by showing that the more fluently a student is able to read, the more they are able to comprehend.

*What effect will a RRI with CR passages delivered through computer software have on the maintenance of oral reading fluency on generalization passages (AIMSweb) by first grade urban learners who are ELLs after intervention?*

The results for this question are not completely clear, given that there was only one week available between the end of school and the stoppage of intervention, many students maintained AIMSweb scores similar to those seen towards the end intervention. Additional time would be required to fully answer this question. Each participant’s maintenance score was higher than his/her average AIMSweb score during intervention, but two participants (Nico and Isabelle) scored lower on the maintenance probe than they
had on their final generalization probe during intervention. Further, according to the DIBELS NEXT benchmarks, only one participant (Isabelle) reached an ORF score that placed her at benchmark. The other two, who indicated the most need for intervention, still demonstrated the need for continued intervention.

*What effect will a RRI with CR passages delivered through computer software have on the maintenance of comprehension on generalization passages (AIMSweb) by first grade urban learners who are ELLs after intervention?*

Results for the participants’ maintenance probes one week after intervention were mixed. One student (Nico) showed increased correct responses to the AIMSweb Maze story given that the other two participants experienced a drop in correct responses from their intervention average one week after intervention stopped. This data was unexpected given the ORF data did not drop as significantly after intervention stopped. This could have been due to testing fatigue as the participants were given a number of assessments on their final day. With continued intervention, the participants would likely increase their scores further on AIMSweb comprehension assessments.

*What effect will a RRI with CR passages delivered through computer software have on the generalization of oral reading fluency on a cold read of a culturally relevant passage by first-grade urban learners who are ELLs after intervention?*

The one-week maintenance probe on the novel CR passage (shown in Figure 3.1) was in line with the maintenance probe for the AIMSweb probes given at the same time. With the exception of Isabelle, whose cold read data were variable, the other participants’ scores were similar to those from their scores during the cold read. Arya’s maintenance probe was lower than her last intervention cold read, but was still higher than her average
CR score during intervention. Interestingly, each participant scored the same number of CWPM for both their CR passage and their AIMSweb passage maintenance probe.

*How many verbal or physical prompts were necessary for the student to interact with the computer software correctly according to the procedural integrity checklist?*

When examining the task independence of the participants, a checklist was used to follow the student through the program and ensure that they were using the program as it was intended. Therrien and Kunina (2008), Gyovi et al. (2009), and Gibson et al. (2014) all discussed the necessity for reading interventions to be applied with fidelity for them to be most effective. During each session, the primary researcher kept a running tally of the number of task prompts from the researcher required for the student to complete the session for the day. Examples of a task prompt could be pointing to the screen to direct the student’s eye gaze, asking “what should you do now” when the participant has paused for five or more seconds, and most commonly “what should you do when you see a graph” if the student did not do so. A behavior tally was also kept for each session, behavior prompts included prompting the student to speak louder or sit still.

The data from this indicate that students performed at a different level of independence across their intervention sessions. For example, Nico the Tier 1 participant required the most prompting at the beginning of his intervention, and never reached independence on more than one session as he required prompting to follow along with the computer’s highlighting, prompting to follow the computer’s instructions, or to raise his hand when he saw a graph. The Tier 2 and 3 participants (Arya and Isabelle, respectively) required less prompting than their Tier 1 peer, but frequently required a prompt to raise their hand when they saw a graph, therefore never reaching
independence. Nico was the oldest of the three participants, so age was not a corresponding factor. He was, however, the student with the highest level of reading risk, which may have led to more escape-oriented behaviors.

*How many sessions did it take for the students to use the computer software independently of researcher prompts according to the procedural integrity checklists?*

This research question was never achieved as no student was able to achieve independence across multiple sessions. Isabelle’s data suggests she was the closest to achieving independence, however, frequently required prompting to raise her hand when a graph was shown. This was not a command given to the student by the computer, but rather a step the student was to accomplish independently. To promote independence, incorporating this instruction into the computer’s script would be helpful.

**Anecdotal Observations**

**Nico**

Nico was a very friendly and excited student who was repeating his first grade year due to poor reading skills. His English Proficiency score on the OTELLA showed that he was the lowest of all the participants (composite score: 2), struggling most with writing (1) and reading (2) but demonstrating proficiency in both the Listening (3) and Speaking (4) subtests. Due to his age, Nico was larger than many of his classmates and was teased frequently. He often did not want to walk in the hallways when the second graders were waiting for the bathroom because they made faces at him. Nico missed approximately two weeks of school because of serious illness. This, however, did not appear to affect his overall reading scores.
Nico’s progress during intervention showed that the explicit instruction of the CAI was effective in increasing his CWPM and comprehension, but he would need to continue getting intensive reading intervention to reach benchmark for his grade level. Although not formally diagnosed, considering his grade retention and generally slower/lower performance, there may have been some cognitive impairment requiring more prompting for Nico than other students. This suggests more research is needed to determine the realistic expectations for pupil independence while using the Reading RACES intervention. It is possible that self-directed learning is a realistic expectation for low-performing first grade students, but those with or bordering on intellectual disabilities may require substantially more training/prompting. Nico’s independence data showed that he was never able to fully interact with the program without the prompts of a researcher. Additionally, Nico often required behavior prompts because he wished to talk to the researchers during intervention or use the tracking pad instead of the mouse. Overall, Nico made noticeable gains during intervention and went from stating “I can’t, that's too many words” during the first session to saying “I’m going to read because that's not a lot!” on his final story. This indicates a change in his confidence as a reader.

Arya

Arya was a very quiet first-grade student who required reading glasses and would answer questions from the researcher with one-word answers or head nods. When intervention first began, Arya required prompts to speak louder, but quickly began adjusting her speaking volume when she placed the headphones over her ears. Because she was so quiet and timid, the researcher had difficulty gaining insight into her backgrounds and interests, however, she did state that she came from Somalia when she
was three years old. Arya struggled to use the mouse during intervention; her hand was shaky, and she had difficulty clicking on unknown words or selecting her name from the drop down menu. Additionally, when she was reading her voice was very shaky. This may have contributed to her slow ORF gains as interacting with the program was more difficult. Considering her early childhood background, likely coming to the United States with refugee status or otherwise low-socioeconomic conditions, there may have been some birth defects or other existing medical condition that contributed to her mild but noted physical differences.

**Isabelle**

Isabelle was a very shy first grade student who her teacher described as “only speaks when spoken to and rarely above a whisper.” Isabelle was from a Somali speaking household and was brought to the United States when she was two years old; other background knowledge about her is unclear. Isabelle was able to move quickly through the program, receiving the fewest number of task prompts, but never fully reached independence using the program. Isabelle frequently received prompts from the researcher to speak louder and the computer had difficulty understanding her when she read for intervention prompting her to “click on the word you are stuck on” despite reading fluently. During the social validity questionnaire, Isabelle revealed this was a source of insecurity for her during the program and that she did not want to continue working on the computer because “her voice was too little”. Isabelle stated that she had not used a computer previous to the intervention but quickly adapted to using the mouse and the Reading RACES software.

**Limitations**
The Software

This CAI software was still being developed and was not fully independent of the researcher. Humans were needed to provide prompts to participants if they were not moving through the steps of intervention. Additionally, the researcher was needed to put in the verbal errors (i.e., words missed that the student did not click on) after each CR, LTM, and CR to assist the computer in calculating the CWPM. The computer offered consistent timings for each reading and maze, but the researcher ensured the computer’s highlighting, maze grading, and graphing was accurate before the student began intervention. This study reflects the extent to which the CAI was helpful to the students, but the technology must be developed further to become fully independent of adult supervision. For some students, their behavior may impede their ability to work without great adult supervision, and would not move through the program with high fidelity. This extended the results of Hammond et al. (under review), which indicated that students with frequent off-task behaviors did not gain as much from the program.

Additionally limiting the study was the unique quality of the participant’s voices and the computer’s ability to pick up the voice of a soft spoken child. Isabelle and Arya both spoke very quietly and often the computer did not register they were reading and would prompt them to “click on the word you are stuck on” despite reading in their normal voices. While the participants were frequently given a verbal prompt to read more loudly, utilizing a more sensitive and specialized microphone would greatly help the computer recognize when the student was stuck on a word to help move through the intervention more smoothly.
Finally, a large limitation to participants becoming independent of the researcher during their intervention was the lack of a computer-scripted prompt to raise their hand when presented with a graph. This step was the only step the computer did not verbally remind the participant to complete. Functionally, this step was incorporated so multiple students could use the software at one time. A hand raise would call attention to a student during key points of the intervention process and allow the researcher/teacher to collect data on the student’s overall progress. However, in the one-on-one setting used for this study, this step was superfluous. If removed from the task data, Arya and Isabelle would have been able to reach independence when using the Reading RACES software. Future research with this software should incorporate a verbal prompt for the student to raise their hand to get the attention of the researcher/teacher.

**One-On-One Setting**

This study took place in the library where the ELL teacher and Reading Intervention Specialist worked with their students. All the participants had great procedural integrity scores, but the distractions around them were far less than they would be in the classroom. Since each participant had at least one researcher with them at all times, there may have been an increase in productivity. Future research should focus on the effects of minimal researcher or teacher assistance and attention, having larger groups of students receiving intervention at the same time, and working with the software in a classroom.

**Other Limitations**

Although the CR stories were analyzed by students in a previous study (Cartledge et al., in press) not all the stories created were applicable to the Somali population. The
names used were often difficult for the participants as they were reflective of the whole African American population, but not necessarily the Somali-American population. When the three were asked to chose their favorite story, one participant (Isabelle) chose a story that specifically mentioned a student from Somalia or a component of the Somali-American culture (New Student). Interestingly, Isabelle also said that she disliked a story with a mention of Somalia (Snow Angels).

Second, only one measure of comprehension (i.e., the maze) was used in this study. Incorporating oral retells, answering open-ended questions, or responding to inferential questions might give a more comprehensive understanding of the student’s comprehension. This would be especially important since the intervention provides the student with so many opportunities to read the story before taking the Maze. However, Parker, Hasbrouck, and Tindal (1992) stated that mazes are considered the most accurate comprehension measurement for this age group and allowed the researchers to compare the CR mazes to the AIMSweb mazes in a standardized comparison.

Finally, time and weather were limiting factors in this study. The intervention was done during a particularly harsh winter and school was canceled for many days. Further, due to the poor weather, many students missed days even when school was not cancelled at the beginning of intervention. This led to difficulties for participants (Nico and Arya) who had just been trained on the intervention, and may have led to more prompts than necessary to get through the program. Further, with delays in the creation of the CAI and the school schedule, Arya and Isabelle did not have enough time to get through the entire intervention. With extended time, all three participants could have continue to approach or exceed the ORF benchmark. This also led to maintenance testing
occurring only 1-week after intervention had stopped and no time for language assessments. In the future, research should look at the effects of the Reading RACES intervention being used across the entire school year, with more stories.

**Future Research**

**Story Selection**

As previously discussed, the usages of CR material may increase fluency and comprehension for young students. Future studies should compare using the Reading RACES software to compare CR and NCR materials to better explore the importance of the materials. In addition, creating more stories for usage during the intervention with names tailored to the participant’s culture that would be used for the entire school year to see the lasting effects of the intervention would be a critical study for this research.

**On-task Behavior**

One of the participants (Nico) demonstrated off-task behavior that increased the length of time needed for his intervention and created a need for the researcher to deliver behavior prompts to complete his intervention. Across his interventions, the number of prompts that Nico required to stay on-task during intervention varied between 1-6, but did not decrease over time as his task prompting data did. As Bennett et al. (under review) discussed, future studies should examine interventions to help the students decrease off-task behaviors and therefore, decrease the amount of researcher assistance needed for the student to receive intervention with fidelity.

**Prosody**

The National Reading Panel defines ORF as “speed, accuracy, and with expression” (2000). This study looked at both speed (CWPM) and accuracy (no less than
92%) but did not examine the expression of the students. Using the CAI, voice modeling, and participant recordings, future studies could use the technology to measure the effects the reading RACES software had on expression over both novel and practiced passages. Developing the software to examine inflection, pauses between words and punctuation, and appropriate phrasing, then developing instruction for the participant to increase fluency as a whole.

**Social Validity**

The social validity questionnaire used was not effective for all participants. It is possible that the questions were too advanced for first grade students, because it asked them to remember all of the stories in intervention, as well as think deeply about their interactions with the software. Using a rating system (i.e., I really liked it, I liked it, it was okay, I did not like it, I really did not like it) would give the students options to express their views, but also would simplify the process for the participant. Further, asking the participant if they liked the story immediately after intervention may create a better understanding of what the participant liked about each story. Additionally, having a survey at the beginning of the study that gauged their familiarity with technology either at home or in the classroom would be helpful to beginning the intervention. This would be especially helpful for participants like Arya who struggled with using the mouse. A program to help participants without experience learn to use the mouse would also be helpful in decreasing the amount of prompting necessary.

**Implications for Practice**

The positive results of this CAI delivered RRI using CR indicate that this software would be effective as a supplemental reading instruction for first grade students
who are ELLs and at-risk for reading failure. Using the CR passages may help the process of practicing fluency skills because it allows the student to connect to their background knowledge, including their known vocabulary words. When the software is fully developed, Reading RACES may provide a way for students to practice their reading fluency independently, while receiving evidence-based practices and freeing the teacher to assist other students in the classroom. Further, with the ability for teachers to add in their own stories, this software can be adapted for any population.

Since this program is computer-based, it can be used in areas outside of the classroom. Using the program as a component of summer camps, or in other areas, could help students maintain their reading skills to avoid falling behind when school is not in session. Additionally, using more difficult and age appropriate stories for second and third graders could help students in these grades to supplement their reading instruction and decrease their risk of failing the third-grade reading guarantee.

Further, as computers and technology become more integrated into the classroom and world, instructing students to use this technology as a reading tool could create a reliable reading intervention, while familiarizing the student with this technology.

**Conclusion**

This study extended and supported the previous research of Bennett et al. (2014) and Gibson et al. (2009) and provided a look at the positive effects of RRI and CR passages delivered through CAI. The study showed that when the students practiced passages in order to reach a goal, over time, their generalization to novel passages began to occur. The data showed that the Reading RACES intervention promoted positive percentage growth rates over both ORF and comprehension scores. Although the
findings did not show all the participants moving out of the at-risk category according to DIBELS NEXT, the data indicated that the intervention allowed the participants to make important gains, as a supplement to their daily reading instruction. The need for students to read fluently and comprehend larger amounts of difficult texts will increase as the participant goes through school. If they do not close the gap in the younger grades, the student will fall further and further behind as the grades and text difficulty increase.

Further, the Reading RACES program was an effective way to promote reading motivation among the participants. By providing them with stories that interested them, the students were more motivated to learn with the program. Students were able to work through the program with an increasing level of independence, though none of the students fully reached independence. Creating a RRI instruction that can be implemented with fidelity across participants, without much adult intervention, would be helpful for teachers who are already short on resources and time in the classroom. Therefore, this software would be helpful for use in a classroom as supplemental reading instruction for students who are falling behind.

Finally, this software helped increase the comprehension for both practiced passages and novel passages during intervention. As a student reads more fluently, the student is able to read more of the options for the Maze and answer the questions with more accuracy. This software also helped increase the participant’s familiarity with using the computer. The participant was able to improve using the mouse, navigating the Reading RACES software, work through each of the steps and make selections on multiple choice tests (Mazes) and improving computer reading fluency. This could be
increasingly helpful when the student takes standardized tests or complete other activities on the computer.
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Read Naturally. www.readnaturally.com


Appendix A: List of Culturally Relevant stories
List of Culturally Relevant (CR) stories in alphabetical order with Spache readability:

Note (E) = expository.

<table>
<thead>
<tr>
<th>CR Story Name</th>
<th>Spache Readability</th>
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<tr>
<td>Artist Laquita</td>
<td>2.3</td>
</tr>
<tr>
<td>Ben Carson (E)</td>
<td>2.0</td>
</tr>
<tr>
<td>Caring Friend</td>
<td>2.1</td>
</tr>
<tr>
<td>Charles Turner (E)</td>
<td>2.0</td>
</tr>
<tr>
<td>Dad’s Hoppin’ John</td>
<td>2.1</td>
</tr>
<tr>
<td>Dancing Jaycee</td>
<td>2.3</td>
</tr>
<tr>
<td>Every Day Counts</td>
<td>2.3</td>
</tr>
<tr>
<td>Football in the Park *</td>
<td>2.2</td>
</tr>
<tr>
<td>George Washington Carver (E)</td>
<td>2.1</td>
</tr>
<tr>
<td>Grandma’s House</td>
<td>2.0</td>
</tr>
<tr>
<td>Grandma’s Pancakes</td>
<td>2.3</td>
</tr>
<tr>
<td>Grandma’s Visit</td>
<td>2.0</td>
</tr>
<tr>
<td>Grandpa’s Sweet Potato Pie</td>
<td>2.0</td>
</tr>
<tr>
<td>Hide-and-go-Seek</td>
<td>2.1</td>
</tr>
<tr>
<td>Hopscotch Game</td>
<td>2.3</td>
</tr>
<tr>
<td>Jolita’s Birthday</td>
<td>2.0</td>
</tr>
<tr>
<td>Mama Works</td>
<td>2.0</td>
</tr>
<tr>
<td>Marcus Runs</td>
<td>2.1</td>
</tr>
<tr>
<td>My Sister</td>
<td>2.3</td>
</tr>
<tr>
<td>New Student</td>
<td>2.3</td>
</tr>
<tr>
<td>Party for Sister</td>
<td>2.0</td>
</tr>
<tr>
<td>Peanut (E)</td>
<td>2.0</td>
</tr>
<tr>
<td>Sam the Superhero</td>
<td>2.2</td>
</tr>
<tr>
<td>Snow Angels</td>
<td>2.1</td>
</tr>
<tr>
<td>Sweet Potato (E)</td>
<td>2.0</td>
</tr>
<tr>
<td>Top Readers</td>
<td>2.3</td>
</tr>
</tbody>
</table>

* Denotes Training Story
Appendix B: Maze Screen Shot
Arthur Ashe was a thin kid that grew up to be one of the best tennis players in the world. As a small child he liked (if to wonder) read books and listen to music (without only with) his mother. He also spent lots (of for my) time practicing. He became so good (course that win) he played at school and later (coming she he) played on the United States (flag team history). He was the best player in the (country pool point).

Arthur played tennis all over the (break world neighborhood) and he was the first black (woman man maybe) to play in some of the (songs games number). One time, one country would not (show visit let) him play because of the color of (his their dry) skin. He did not think this (down should was) fair and he worked to make (mind prizes changes) so all people could play. He (did's did spring) make things better.

Mr. Ashe was a (hardly happen very) smart man. That is why he was (park not so) good at tennis. He knew how (to back with) play smarter than many other men. (They He Loud) was also a very kind (nice mean fee) man. Mr. Ashe always wanted to (be find fantastic) a good person. When he was (young hungry plant), his dad kept telling him that he (should going sunny) always do the right thing, and (that clever) is what he did. He always (worked sang floor) hard to do his best and to (do drop room) what was right.

After he finished (playing early set) tennis, Arthur still helped people. Later (in live letter) his life he became sick but he (still mess while) worked to help others. People still (remember requested money) what a wonderful man he was. (There Then Must) is even a tennis court in New York (that about food) is named after him.
Appendix C: AIMSweb stories
<table>
<thead>
<tr>
<th>Aimsweb Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP</td>
<td>Chris Was Not</td>
</tr>
<tr>
<td>1</td>
<td>Goodbye Mom</td>
</tr>
<tr>
<td>1</td>
<td>Sam was Happy</td>
</tr>
<tr>
<td>PP</td>
<td>Hope was the</td>
</tr>
<tr>
<td>1</td>
<td>The Bird Feeder</td>
</tr>
<tr>
<td>PP</td>
<td>Fred is Slow</td>
</tr>
<tr>
<td>PP</td>
<td>Billy has a</td>
</tr>
<tr>
<td>1</td>
<td>It was Mr. Bees</td>
</tr>
<tr>
<td>PP</td>
<td>One day Jack</td>
</tr>
<tr>
<td>1</td>
<td>Jeff was Happy</td>
</tr>
<tr>
<td>1</td>
<td>John was Walking</td>
</tr>
<tr>
<td>1</td>
<td>A boy Named Tom</td>
</tr>
<tr>
<td>1</td>
<td>Cat Loved Bird</td>
</tr>
<tr>
<td>PP</td>
<td>Josh and Chris</td>
</tr>
<tr>
<td>PP</td>
<td>Molly Lives On</td>
</tr>
<tr>
<td>1</td>
<td>Mom and Dad</td>
</tr>
<tr>
<td>PP</td>
<td>Grace and Beth</td>
</tr>
</tbody>
</table>
Appendix D: Training Checklist
<table>
<thead>
<tr>
<th>Trainers Actions</th>
<th>Yes</th>
<th>No</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asked student to put on headphones; adjusted microphone so that it is in front of student’s mouth; ask participant to adjust the computer screen for best view.</td>
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<tr>
<td>Explained setting of the ORF goal using script; student adjusted CWPM based on their goal.</td>
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</tr>
<tr>
<td>Then, student selected and listened to the program directions (“Hi, I’m Betty Buckeye…”). Student able to click “yes/no” after prompt given.</td>
<td></td>
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</tr>
<tr>
<td>Checked if participant can use a mouse by having them click on training story “Football in the Park”</td>
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<tr>
<td>Go through Pre-Teaching feature saying the correct words</td>
<td></td>
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<tr>
<td>Select cold read and Read aloud for 1-minute</td>
<td></td>
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</tr>
<tr>
<td>Student listened to the story 1 full time and eye gaze followed the blue highlighting feature.</td>
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</tr>
<tr>
<td>Student follows direction to move through the different steps.</td>
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</tr>
<tr>
<td>Students click <strong>listen to me</strong>; student read independently for 1 min. Took a running record of this practice timed reading.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Student click <strong>timed reading</strong>; completed timed reading by recording errors and computed CWPM (i.e., treatment probe).</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Raise hand after Timed Reading graph is displayed</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Student click <strong>MAZE comprehension passage</strong>. Student was able to successfully click on missing words in the practice</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
passage.

<table>
<thead>
<tr>
<th>Raise Hand after Maze graph is displayed</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Asked if there were any questions about the program; asked what the best part about the program was and recorded answer; asked what they would like to change about the program and recorded answer.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix E: Culturally Relevant data sheet
Ben Carson

Ray loves school. He wants to be a doctor some day, just like Ben Carson. Ben is black like Ray. Ben Carson is a doctor for children. He helps over 300 children every year. One time Ben was the only doctor who could help some very sick children. A doctor helped Ray’s little sister feel better when she was sick. Ray wants to be a doctor so he can help children feel better. Doctors also help children stay healthy so they don't get sick. Doctors must work hard in school for many years. Anyone can be a doctor if they work hard in school and get good grades. Ray really wants to be a doctor. He plans to work hard.
Appendix F: Screen Shot of Intervention
Arthur Ashe was a thin kid that grew up to be one of the best tennis players in the world. As a small child he liked to read books and listen to music with his mother. He also spent lots of time practicing. He became so good that he played at school and later he played on the United States team. He was the best player in the country.

Arthur played tennis all over the world and he was the first black man to play in some of the games. One time, one country would not let him play because of the color of his skin. He did not think this was fair and he worked to make changes so all people could play. He did make things better.

Mr. Ashe was a very smart man. That is why he was so good at tennis. He knew how to play smarter than many other men. He was also a very kind and nice man. Mr. Ashe always wanted to be a good person. When he was young, his dad kept telling him that he should always do the right thing, and that is what he did. He always worked hard to do his best and to do what was right.

After he finished playing tennis, Arthur still helped people. Later in his life he became sick but he still worked to help others. People still remember what a wonderful man he was. There is even a tennis court in New York that is named...
Appendix G: Social Validity Questionnaire
1) Did you like reading on the computer?
   a. Yes
   b. No
   Why?

2) Do you think you became better at reading new stories on paper?
   a. Yes
   b. No
   Why?

3) Did you like charting your data?
   a. Yes
   b. No
   Why?

4) Would you like to continue to read on the computer?
   a. Yes
   b. No
   Why?

5) Do you think the other kids in your class would like this program?
   a. Yes
   b. No
   Why?

6) Use the mouse to find your favorite story. Why was it your favorite?

Name of story:
Reason:

7) Use the mouse to find your least favorite story. Why did you dislike this story?
Name of story:

Reason:
Appendix H: Treatment Integrity Sheet
Student: ______________ Date:_________ Experimenter : _______ Observer:______

Story Title: _______________________

| Used script to ask student to put on headphones; adjusted microphone so that it is in front of student’s mouth; ask participant to adjust the computer screen for best view. Used script to test microphone. | Yes | No | Comments |
| Prompted student to find their name; Showed student data chart and explained ORF goal; asked student to set goal in computer | | | |
| Prompted student to click on “listen” to the introduction; prompt to click on “yes” or “listen again” if does not respond | | | |
| Presented story title using script and asked student to click on assigned story; prompted student to click on “Read to Me” | | | |
| After Read to me recording is over, prompted student to click on “Read Along” | | | |
| After read along is over, prompted student to click on “Listen to Me”; when timing is over, use script. | | | |
| Bracketed the last word read on passage when time ended on Listen to me and/or Timed Reading; marked errors on data sheet; calculated CWPM; used script to share result with student. | | | |
| Gave corrective feedback on each missed words. Highlighted each word with the mouse and said, “This word is ___. What word? Highlighted the whole sentence and said, “Read the whole sentence.” | | | |
| Repeated Listen to Me up to 3 times; If met goal within 3 Listen to Me’s, prompted student to click on to Timed Reading; if did not meet goal, ended session by using the script. | | | |
| If met goal on Timed Reading, prompt student to click on Maze. | | | |
| Wrote total correct/incorrect on data sheet as copied from the computer window when maze was over. | | | |
| To end the session, charted the timed reading and Maze scores with the student and provided encouragement and praise to the student. | | | |
## Treatment Integrity: Teacher (or Primary Experimenter)

**Student:**

**Date:**

**Experimenter:**

**Observer:**

### Story Title:

<table>
<thead>
<tr>
<th>Adults Actions</th>
<th>Yes</th>
<th>No</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software, mouse, and headphones are set up before student begins intervention; teacher asks student to click on “ORF Tutor”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Makes sure student is reading correct story (either assigns or lets student choose)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Has student start intervention by pointing to graphic organizer and prompts to start cold read.</td>
<td></td>
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</tr>
<tr>
<td>Checks on student periodically during intervention.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Provides feedback and help as needed during intervention, yet allows student to work as independently as possible.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acknowledges student when their hand is raised.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attends to student during Timed Reading and records running record of his/her performance (up to two times); records maze score.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collects/checks data sheets/folder at end of session. Reviews graphs and provides positive feedback to student.</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Appendix I: Computer Checklist
<table>
<thead>
<tr>
<th>ORF-RR Actions</th>
<th>Yes</th>
<th>No</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presents directions, goal, and reading speed option for voice model (On Betty Buckeye screen)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presents selected story</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presents correct story during Cold Read.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivers appropriate feedback after Cold Read based on CWPM.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presents story with correct highlighting during read to me.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presents story during read with me</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presents listen to me button for 3 one-minute timings.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Displays goal time and CWPM after each one-minute listen to me; delivers appropriate feedback based on time (i.e., time met, almost met, or needs more practice).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presents story during timed reading; Timer accurate; displays goal and correct CWPM after the one-minute timed reading.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If goal met, presents MAZE comprehension passage; if goal not met, prompts student to keep practicing ‘listen to me’ for the next session</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix J: Treatment Integrity Participant
<table>
<thead>
<tr>
<th>Student</th>
<th>Date</th>
<th>Trainer</th>
<th>2\textsuperscript{nd} Observer</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjusted computer screen for best view.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Put on headphones and adjust microphone so that it is in front of mouth.</td>
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</tr>
<tr>
<td>Followed menu to test that microphone is working.</td>
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</tr>
<tr>
<td>Found and clicked on their name.</td>
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</tr>
<tr>
<td>Used graph to identify goal and click on appropriate goal under their name.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Clicked <strong>listen</strong> and listened to the program directions (&quot;Hi, I’m Betty Buckeye...&quot;)); click <strong>yes</strong> or <strong>listen again</strong> after prompt given.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Found assigned story in his/her folder and find and click on appropriate intervention story.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Clicked <strong>Begin</strong> after prompt is given; read assigned story 1 full time with a loud clear voice.</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Clicked <strong>Read to me</strong> after prompt is given; listen to the story 1 full time; use eye gaze to follow the blue highlighting feature.</td>
<td></td>
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</tr>
<tr>
<td>Clicked <strong>Read along</strong> after prompt is given; read along one full time with a loud clear voice.</td>
<td></td>
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</tr>
<tr>
<td>Clicked <strong>Listen to me</strong>; immediately started reading after he/she hears <strong>GO</strong>!</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>During <strong>Listen to me</strong>; Reads independently for 1 minute</td>
<td></td>
<td></td>
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<tr>
<td>During <strong>Listen to me</strong>; Clicked on unknown</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>During <strong>Listen to me</strong>; Clicked on unknown words.</td>
<td></td>
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<tr>
<td>--------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During <strong>Listen to me</strong>; Accurately clicked on the last word he/she read</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During <strong>Listen to me</strong>; Followed computer prompt based on his/her performance</td>
<td></td>
<td></td>
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<tr>
<td>Clicked <strong>Timed reading</strong> when prompted; complete timed reading</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>During <strong>Timed Reading</strong>; accurately click on last word he/she read.</td>
<td></td>
<td></td>
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<tr>
<td>Clicked <strong>Maze</strong> when prompted; accurately click on answer choices; charted progress on graph</td>
<td></td>
<td></td>
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<tr>
<td>Used Graphic organizer; accurately recored performance data; gave data sheets/folder to adult</td>
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<tr>
<td>Clicked “Exit” to sign out of the tutor.</td>
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</tbody>
</table>

If student skipped directions, indicate which ones: