A COMPARISON OF TWO READING FLUENCY METHODS: REPEATED READINGS TO A FLUENCY CRITERION AND INTERVAL SPRINTING

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Teachers have used the method of repeated readings to build oral reading fluency in students with and without special needs. A new fluency building intervention called interval sprinting uses shorter timing intervals (i.e., sprints) across a passage. This study used an alternating treatment design to compare repeated readings and interval sprinting for three participants with or at-risk for reading deficits. The results show that the participants attained the fluency criterion on one of the reading practice procedures after approximately the same number of sessions without consensus as to the procedure. Compared to readings in the first phase, students demonstrated higher average initial readings and reached criterion as fast or faster in the second phase, demonstrating reading transfer.

Olympic speed skaters race over distances from 500 to 10,000 meters (approximately 0.3 to 6.0 miles) sometimes exceeding on-ice speeds of 30 miles per hour (Vickers, 2006). Elite marathon runners maintain six minute mile speeds for over two and a half hours with perfect form (Binder, 1996). These athletes have not only mastered the skills particular to their sport, but perform their well practiced behaviors effortlessly and with deft composure. Such rapid and automatic performances fall under the term behavioral fluency. Individuals demonstrate behavioral fluency when they show, "that combination of accuracy plus speed of responding that enables competent individuals to function efficiently and effectively in their natural environments" (p. 163).

While the previously mentioned examples take place in the world of competitive sports, there exists a parallel to academics. Teachers aspire for their students to perform academic behaviors with grace and fluidity (i.e., fluency). For example, teachers strive to have students write dynamic, well-composed manuscripts in English class, diligently work through complicated Algebra problems, or confront problems with critical thinking. In the past, the educational system has not fully embraced fluency in all of its subject matter (Allington, 1983; Kubina & Morrison, 2000). But changes in both research and practice has occurred. Notably, in some subjects like reading fluency interventions have taken center stage (National Reading Panel, 2000).

As researchers have begun to scientifically scrutinize fluency in reading, they have made a number of important discoveries. For example, oral reading fluency, or ORF, provides a quality measure of a

student's overall reading competence (Fuchs, Fuchs, Hosp & Jenkins, 2001; Shinn & Good, 1992). Poor readers display lower levels of ORF than good readers. Students with low ORF often stammer while reading and easily become distracted which adversely affect their understanding and comprehension of text (Binder, Haughton, & Van Eyk, 1990; Fuchs et al., 2001). Students who demonstrate high levels of ORF experience many benefits (Binder, 1996; Fuchs et al.; Kubina & Morrison, 2000). Fluent readers appear to naturally translate text into spoken language appearing to glide while reading (Archer, Gleason, & Vachon, 2003; Fuchs et al.). Because they spend less time decoding, fluent readers also better understand what they read (Mounsteven, 1990; National Reading Panel, 2000; Therrien, 2004).

Time plays a major role in ORF. Even though some have conceptualized ORF as the ability to read with prosody (Schreiber, 1980), Archer et al. (2003) suggest the epitome of ORF breaks down to "rate plus accuracy" (p. 96). This definition places ORF into observable and measurable terms: words per minute. Researchers have found students' one-minute reading samples correlate well to standardized reading assessment scores (Good, Simmons, & Kame'enui, 2001), formatively measure a student's reading progress across time (Deno, 2003), and can assist in the identification of reading deficits and special education needs (Hosp & Fuchs, 2005). Additionally, one-minute reading timings appear often in a useful fluency building method called repeated readings.

Because increased levels of ORF require practice, teachers and researchers need a systematic plan for fluency building (Archer et al., 2003; Kubina, 2005). Repeated reading represents one method for fluency building for students with and without special needs (Chard, Vaughn, & Tyler, 2002; Kuhn & Stahl, 2003; Meyer & Felton, 1999). Kavale (2005) reported a .76 mean effect size for repeated readings for students with specific learning disabilities. Repeated reading interventions have effectively assisted students with speech-language impairments (e.g., Begeny, Daly, & Valleley, 2006), learning disabilities (e.g., Nelson, Alber, & Gordy, 2004; Valleley & Shriver, 2003), and emotional and behavioral disorders (e.g., Scott & Shearer-Lingo, 2002; Staubitz, Cartledge, Yurick, & Lo, 2005). Additionally, researchers have used repeated readings effectively in peer-mediated (e.g., Yurick, Robinson, Cartledge, Lo, & Evans, 2006) and small group settings (e.g., Kuhn, 2005) to build fluency.

At the basic structure of repeated readings, a student reads the same instructional-level passage until meeting a pre-set criterion of words per minute or a specific number of passage reading repetitions while receiving feedback and error correction (Meyer & Felton, 1999; Therrien, 2004; Therrien & Kubina, 2006). Once meeting criterion or number of rereads with the first passage, the student would repeat the process with another passage and so on (Meyer & Felton; Therrien). In his meta-analysis of repeated readings for students with learning disabilities, Therrien reported effect sizes (ES) for critical

repeated reading components: 3-4 rereads (ES= .85-.95), error correction (ES = 1.37), and reading to a criterion (ES = 1.74).

The procedure of repeated readings can take many forms. The student can reread passages as a teacher or peer reads the passage (e.g., Kuhn, 2005), reread the passage without assistance (e.g., Compan, Iamsupasit, & Samuels, 2001), or reread the passage in a prosodic reading format targeting expression and inflection (e.g., Young, Bowers, MacKinnon, 1996). Additionally, timed practice readings can match (e.g., Therrien, Wickstrom, & Jones, 2006; Valleley & Shriver, 2003) or not match (e.g., Begeny & Silber, 2006; Staubitz et al., 2005) the test reading. Regardless of the specific form, the goal of repeated reading remains the same, the development of fluency.

Behavioral fluency shares the functional definition of fluency found in many definitions of ORF (e.g., Archer et al., 2003; Binder, 1996; Fuchs et al., 2001). Behavioral fluency, however, also predicts the associations of critical learning outcomes. One such critical learning outcome, endurance, states that a learner can engage in a task at a uniform rate for a given period of time. Furthermore, the learner can do so in the face of environmental distraction (Binder, 1996; Binder et al., 1990). When placed in the context of reading, endurance means students maintain reading accuracy, rate, and continue reading in the face of distraction. Students who do not have endurance (i.e., yet to achieve fluency) tend to read slower, for shorter intervals of time, and may display more off-task behavior (Binder et al.). To build

endurance, researchers from the field of Precision Teaching, from where behavioral fluency originated, have developed several practice methods. One such method calls for the teacher to use shorter timings called sprints to build endurance (Binder; Haughton, 1980).

The practice of endurance building with academic skills has similar characteristics with athletic endurance building. As an example, Gibala et al. (2006) have found a way to efficiently promote endurance. As a result of comparing sprint interval and traditional endurance training methods, they concluded that sprint interval training produced biological changes similar to endurance training in a time efficient manner. Therefore, the results from athletic training suggest a similar outcome attainable in reading when developing oral reading fluency: interval sprinting. Can an academic sprint-interval training procedure produce results similar to, or better than, reading fluency methods like repeated reading but with the added benefit of efficiency? We present a new method called interval sprinting (IS) to explore the question of efficiency and feasibility.

Interval sprinting with reading involves two main steps. First, a practitioner determines a reading passage for IS practice and equally divides the passage into a specified number of parts (i.e., number of words) based on the length of time per time interval (i.e., number of seconds). Second, while maintaining the parts in context (i.e., passage remains intact), students would spend their time sprinting (i.e., reading aloud) from each of the starting points across the passage. Therefore students have

the opportunity to read the first part of a passage, then the second part, and so on until the end of the passage. Because the passage parts remain in context, an important aspect of repeated readings (Therrien & Kubina, 2007), students may conceivably read quickly enough to practice some aspects of the passage twice as often as compared to students reading the passage for one minute. This additional practice within the same allotment of practice time leads to the possibility of increased reading efficiency during the fluency building procedure.

Even with increased time allocated for reading, Heibert and Fisher (2005) note that teachers should continue to look for the most efficient fluency building methods available. Can modifications to the repeated reading procedures produce both effective and efficient results? The purpose of this study seeks to examine the IS procedure. To do so, we compared IS with repeated readings to a fluency criterion and asked two questions: (a) Under which condition (i.e., IS or repeated reading to a fluency criterion) will students reach criterion first (i.e., 200+ correct words per minute with 2 or less errors) and (b) given equal reading practice time, which condition will students practice reading more words

Methods

Subjects and Setting

Two 10-year-old males, Brad and Joseph, and one 8-year-old male, Jason, participated in this study. From individual parent reports, Brad had a specific learning disability in reading, Attention-Deficit/Hyperactivity, auditory processing, and memory disorders while Joseph had an auditory processing disorder which falls under the other disability special education classification. Both received services in resource room settings and had reading goals on their respective Individualized Education Plans stating they needed additional reading support. Jason did not receive special education services; due to difficulties with reading, he received reading assistance in the form of Title 1.

The experimenter recruited all participants through community referrals from university faculty in a special education program. The study took place during summer vacation; therefore all sessions occurred in each participant's home at either a kitchen (i.e., inside) or picnic table (i.e., outside). The experimenter conducted all sessions and met with each participant every available weekday during the course of the study. Summer activities (e.g., sports camps, family outings, vacations, etc.) affected session days for certain participants. Each session lasted approximately 10 to 20 minutes.

Materials

All readings came from Dynamic Indicators of Basic Early Literacy Skills (Good & Kaminski, 2007). Following reading assessments (noted below in *Assessment/current level of performance*), the experimenter selected four readings from the 6th edition second and fourth grade oral reading fluency progress monitoring packets (Good & Kaminski). Fry readability procedures (Fry, 1989) confirmed

the grade levels of each passage prior to inclusion. Each passage contained separate stories focusing on different topics. Table 1 shows each specific passage number, the number of words per passage, and the word overlap between passages.

Calculating word overlap involved a three step process. (1) After entering every word of each passage into a spreadsheet, a comparison of words followed. (2) Each instance of a word in two passages counted as one overlapping word. Multiple words counted as overlapping only as many times as they overlapped. For example, passage 1 in second grade had the word 'the' seven times. 'The' appeared 10 times in passage 10. Therefore 'the' overlapped seven times within these two passages. (3) Dividing the smallest word total of the two passages by the number of overlapping words between those two passages yielded the percent of word overlap. Second grade passages overlapped 35% on average and 24% on average when not including commonly occurring words (i.e., a, an, and, I, the). Fourth grade passages overlapped 29% on average and 17% on average when not including commonly occurring words.

Additional materials included copies of each passage for the experimenter and participants, a count down timer, No. 2 pencils, and a video recorder and tripod. Each passage copy used by the experimenter had word totals at the end of each line while participant copies had no word count and larger font. To determine timings of reading intervals, the experimenter used a timer that beeped at the conclusion of each interval.

Dependent Variables

Measurement of two dependent variables, words read correctly and incorrectly, took place during this study. Participants read passages aloud to the experimenter who scored correct and incorrect read words on a copy of the passage. Correct words consisted of words pronounced correctly in their appropriate place in the text within three seconds (Shinn, 1989). Also, self-corrected errors counted as correct. Mispronunciations, omissions, substitutions, and words not read within three seconds counted as incorrects (Shinn, 1989). Additionally, inserting additional words not found in the text counted as incorrects. Skipping lines of text did not fall into either a correct or incorrect tally. Measurement of correct and incorrect words occurred during one-minute intervals. Calculation of corrects consisted of subtracting the number of incorrects from the total number words read plus any added words during each interval.

Independent Variable

The independent variable applied during the study had two different conditions: interval sprinting (IS) and repeated readings to a fluency criterion (RRFC).

Interval sprinting condition. Interval sprinting involved asking the participants to read from six specific points within the passage. The specific starting points of each sprint passage came from dividing the first 204 words of a passage into six equal parts, which resulted in six sprint passages of 34 words each. To maintain overall passage congruity, the starting point for each sprint passage occurred in steps

of 34 words (i.e., 1st, 35th, 69th, 103rd, 137th, and 171st words).

To begin the condition, the experimenter provided the participant with an unmarked copy of the passage and told them that they would read aloud from six different parts of the passage for 10 seconds twice and to read as fast as they can. The experimenter's copy of the passage had the six starting points circled, and a running word total at the end of each line. After setting the count down timer for 10 seconds and prompting the participant to read from the 1st word, the experimenter had the participant start reading while recording incorrect words and marking the final word read. After the timer beeped, the experimenter prompted the participant to stop reading and quickly tallied and noted corrects and incorrects without providing feedback. The experimenter reset the timer for 10 seconds and prompted the participant to read from the first word of the 1st part again. The experimenter again scored incorrects and the final word read as the timer expired. The experimenter again silently tallied and noted corrects and incorrects.

Once the participant completed two readings for the 1st sprint passage, regardless of performance, the experimenter prompted him to start reading from the beginning of the 2nd sprint passage (i.e., the 35th word). The participant then read the 2nd sprint passage twice for 10 seconds each with the experimenter again recording corrects and incorrects without providing feedback. After the second timing for the 2nd sprint passage, the participant moved, with prompting, to the 3rd sprint passage (i.e., 69th word). Again, the participant read this part twice for 10 seconds without feedback.

After the second timing of the 3rd passage, the experimenter provided verbal feedback and error correction over the first six sprints. Verbal feedback consisted of explaining the number of correct and incorrect words read per sprint passage reading. Error correction comprised a model-lead-test procedure (Carnine, Silbert, Kame'enui, & Tarver, 2004). Every word mispronounced, omitted, substituted, skipped, or hesitated on for longer than 3 seconds received the same type of correction. The experimenter pointed to the word on the participant's copy of the passage and stated, "This word is _____. What word?" The participant had to pronounce the word properly. When the participant added words into the passage, the experimenter pointed to the word that occurred just before and just after the added word and said, "These words are _____ and _____. What words?" The participant had to pronounce both words properly. The experimenter repeated this process for every error made over the course of the first six sprints.

Following oral feedback and error correction, the experimenter repeated the above procedure with the remaining three sprint passages. In other words, the participant read, with prompting and timing from the experimenter, the 4th, 5th, and 6th sprint passages twice each for 10 seconds. Following verbal feedback and error correction over the final six sprints, the experimenter had the participant read from the start of the overall passage for a one

minute test.

Repeated readings to a fluency criterion condition. Repeated readings to a fluency criterion (RRFC) condition involved the participant reading the targeted passage for one minute twice. To start this condition, the experimenter provided the participant with an unmarked copy of the passage and some initial instructions. The experimenter told the participant that he would read the passage twice for one minute each time and to read as fast as possible. Setting the timer for 60 seconds and prompting the participant to start at the 1st word of the passage, the participant started reading and continued until the timer beeped. The experimenter recorded incorrects on a copy of the passage that included a running word total at the end of each line. The experimenter provided verbal feedback in the form of correct and incorrect words read and performed error correction identical to the error correction discussed in the IS condition. The experimenter conducted identical procedures for the second reading before having the student complete a one minute test reading of the passage.

Experimental Design

The experimenter used an alternating treatments design (Kennedy, 2005) to evaluate the effects of the IS and RRFC conditions. Because each session included one instance of IS and one instance of RRFC, each session started with an alternating procedure. The alternating treatments design does not require baseline, however, all participants had one unpracticed initial reading of each passage before

starting practice procedures. The preliminary reading of the first two passages served as both a reading level assessment and a current level of performance. The preliminary reading of the second two passages served as a current level of performance.

One concern of using an alternating treatments design with reading involves interaction effects. In other words, the reading of one passage can affect the reading of the other or future passages. In an attempt to minimize these potential interaction effects, all passages within a grade level had a percentage of word overlap calculated that did not exceed 30% when controlling for some common words used in most readings and all passages contained independent content.

Procedures

Assessment/current level of performance. To assess current level of performance, participants read two passages. Because this study took place during the summer, initial passage grade levels mirrored the grade each participant completed the past school year. Using ranges presented by Kubina and Starlin (2003), participants reading between 0-49 correct words on either passage would read two new passages from one grade earlier. If participants read more than 150 correct words per minute on either passage they would read two new passages from one grade level above that passage. The assessment stopped when a participant read between 50 and 149 correct words in one minute on both passages placing them in the instructional level for the current pas-

sages (Kubina & Starlin). This final reading counted as the current level of performance for these two passages. Brad and Joseph, both recently completing the fourth grade, read fourth grade passages at the instructional level and Jason, recently completing second grade, read second grade passages at the instructional level.

Sessions. Prior to the start of the first session of each phase, the experimenter randomly chose one of the passages for the IS condition and one of the passages for the RRFC condition. Once assigned, each passage remained within its condition until the participant read one of the two passages to fluency criterion. All sessions contained one IS and one RRFC condition. Therefore, the participant would complete one of the two conditions and a test before moving to the other condition and test on the other passage. The starting condition alternated for each session. At the conclusion of each session, the experimenter provided a small age-appropriate prize based on participation, not performance (LeBlanc, Coates, Daneshvar, Charlop-Christy, Morris, & Lancaster, 2003). The experimenter gave the prize following the last test. During this time, the experimenter and participant cleaned up reading and recording materials and talked about summer activities. Sessions in the first phase continued until the participant read one of the two passages at the fluency criterion (i.e., 200 or more correct words per minute with two or fewer errors) (Freeman & Haughton, 1993; Kubina & Starlin, 2003).

Once a participant reached the fluency criterion, he began the second phase. The second phase started with an initial, unpracticed reading of two passages of the same grade level as passages from the first phase. After randomly assigning the two passages to one of the two conditions, the experimenter conducted phase two in the exact same manner as phase one.

Tests. At the conclusion of each condition, the experimenter tested each participant on the current passage. The experimenter set the timer for 60 seconds and prompted the participant to begin reading from the first word of the passage. Once reading, the experimenter recorded incorrects and noted the word reached when time expired. Without performing an error correction procedure, the experimenter debriefed the participant on the number of words read correctly and incorrectly.

Interscorer Agreement

An independent observer provided interscorer agreement (IA) and procedural integrity (PI) measures for a randomly selected 25% of the sessions' video recordings. Prior to performing IA and PI, the observer engaged in training sessions. These sessions consisted of the independent observer watching video tapes of participants. The independent observer then measured words read correctly and incorrectly and compared their scores to a predetermined true value. This training process continued until the participant maintained 90% agreement with correct scores.

To calculate IA, the experimenter used a total agreement approach for both correct and incorrect words (Kennedy, 2005). To calculate total agreement per observation,

the experimenter divided the larger amount of observed words, read either correctly or incorrectly, by the smaller amount of observed words, read either correctly or incorrectly respectively. Overall, average total agreement measured 88.1%.

Procedural Integrity

The same independent observer, who calculated IOA, assessed procedural integrity on 25% of the sessions. To calculate procedural integrity, the observer reviewed each session previously used for IA and completed a checklist verifying the specific steps of the procedure. Average procedural integrity came to 99.7%.

Social Validity

To measure social validity parents and participants provided information pertaining to the procedures and outcomes of the study. The questions focused on involvement in the study. Participants orally responded to three questions: (a) Did you enjoy participating in this study? Why or why not, (b) Which reading procedure did you like better, 1 minute (i.e., RRFC) or 10 seconds (i.e., IS)? and (c) Which one did you feel helped you more, 1 minute (i.e., RRFC) or 10 seconds (i.e., IS)? After receiving training in both procedures, parents responded with written answers to four questions at the conclusion of the study: (a) Did you feel that your child benefited from their participation? (b) Did you notice anything different about your child as they progressed through the study? (c) If possible, would you like to see this type of "reading" done in their classroom at school? (d) Would you do this with your child by yourself?

Results

Figures 1, 2, and 3 display the correct and incorrect words read per minute by Brad, Joseph, and Jason, respectively, during both phases. The solid black dots represent correctly read words and the solid black squares represent incorrectly read words for each assessment passage of the repeated reading to a fluency criterion (RRFC) condition. The open black dots depict correctly read words and the open black squares represent incorrectly read words for each assessment passage of the Interval Sprinting (IS) condition.

Unpracticed Initial Readings. The first two readings of the 1st phase served two purposes: determining appropriate passage grade level and an unpracticed initial reading score. Each participant scored in the instructional range on grade level passages (i.e., Brad and Joseph, 4th grade, and Jason, 2nd grade). Prior to the 2nd phase, two data points show each participant's unpracticed initial readings of the next two passages. A comparison between these two sets of data points for each participant reveals two important effects. First, each student scored approximately the same both within and between phases showing similarities in difficulty across the passages. Second, the average words correct on unpracticed initial readings increased by approximately four words from the 1st to 2nd phase.

First Phase. Two of the three participants first met the fluency criterion under the IS condition. Jason read 211 correct with 1 error during the 14th session and

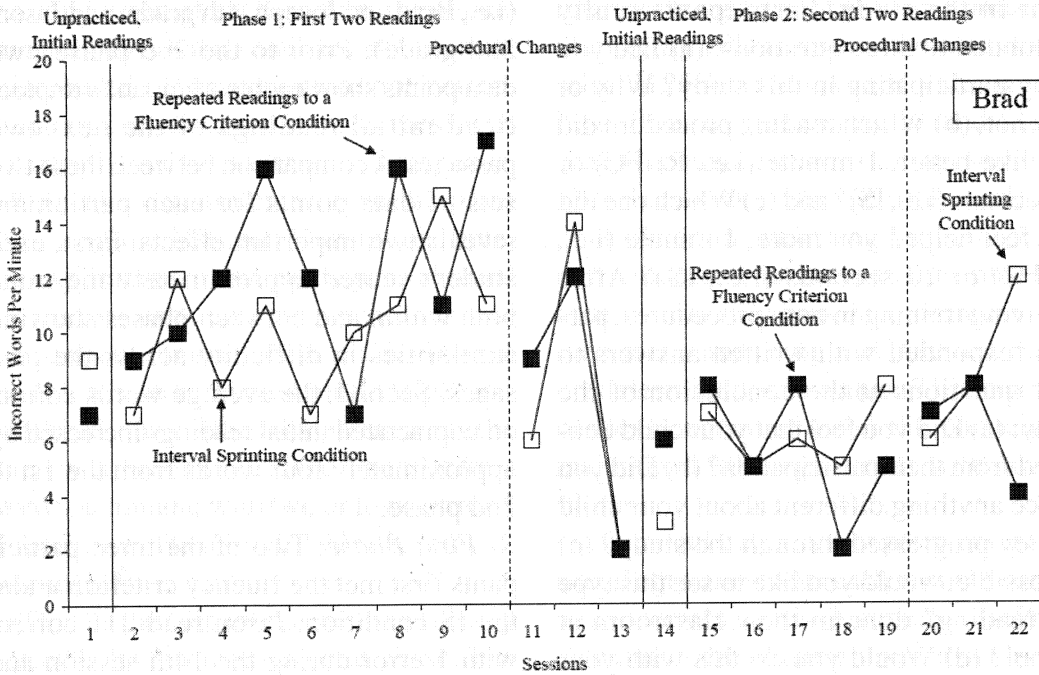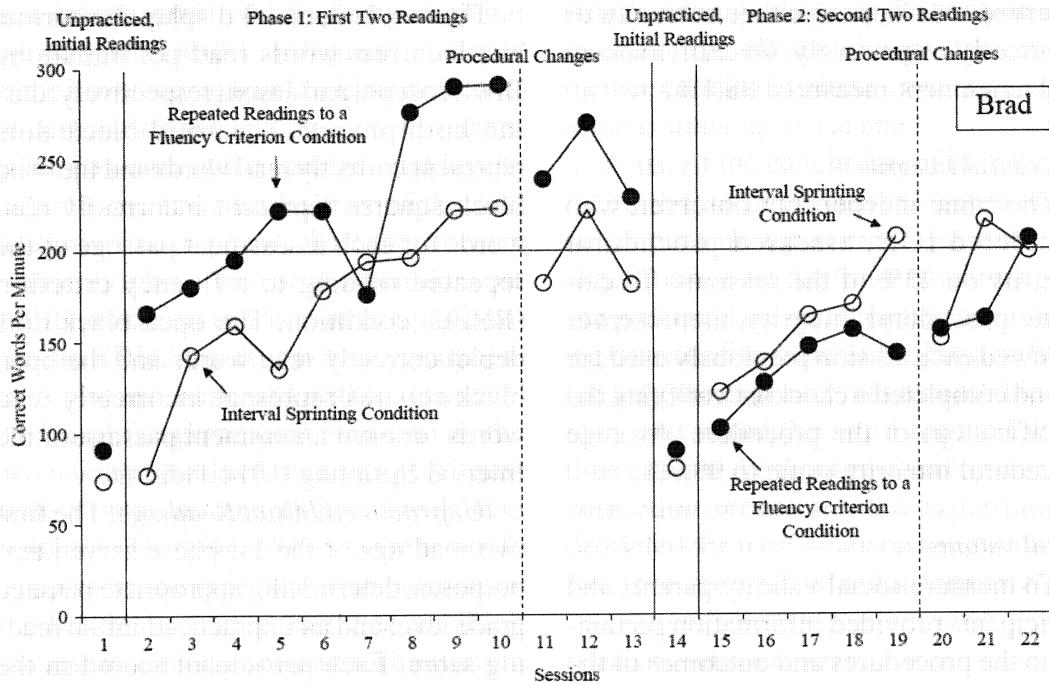Figure 1. Correct and Incorrect words per minute read by Brad across both conditions and phases

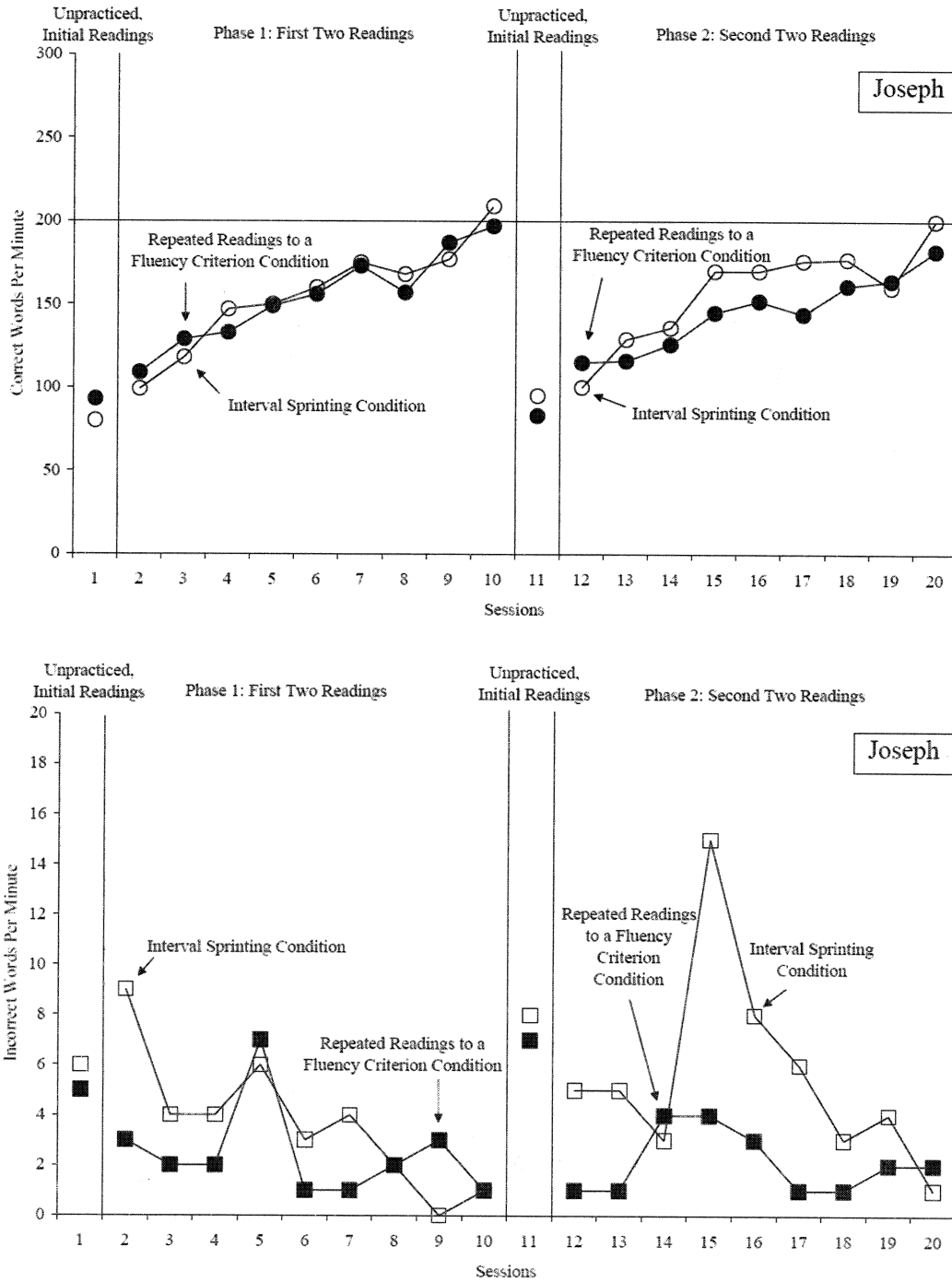Figure 2. Correct and Incorrect words per minute read by Joseph across both conditions and phases
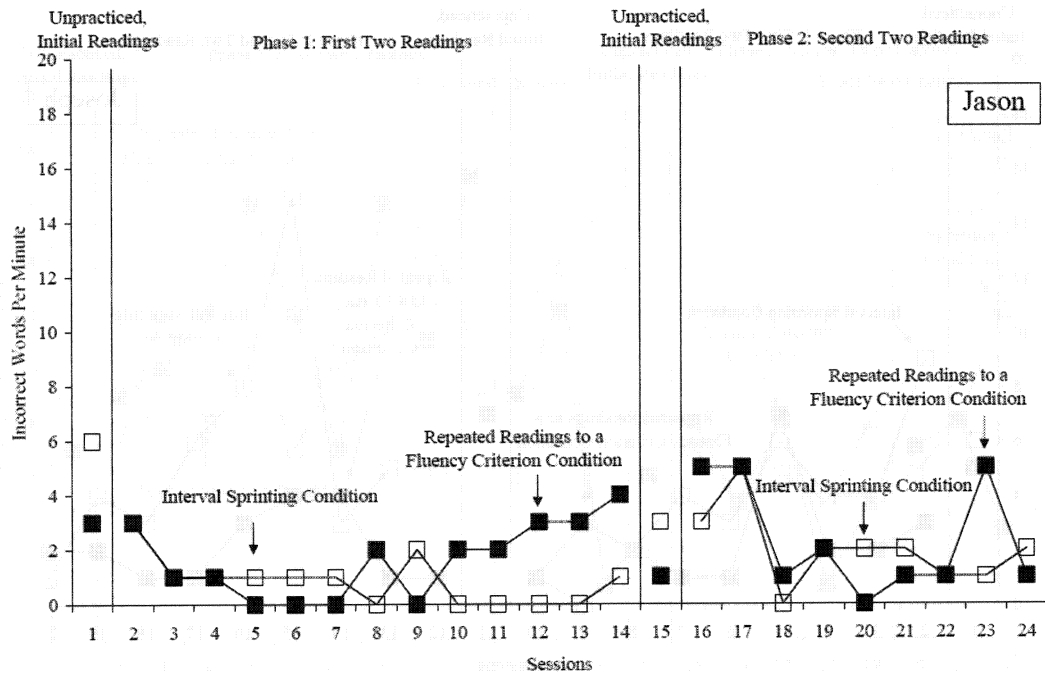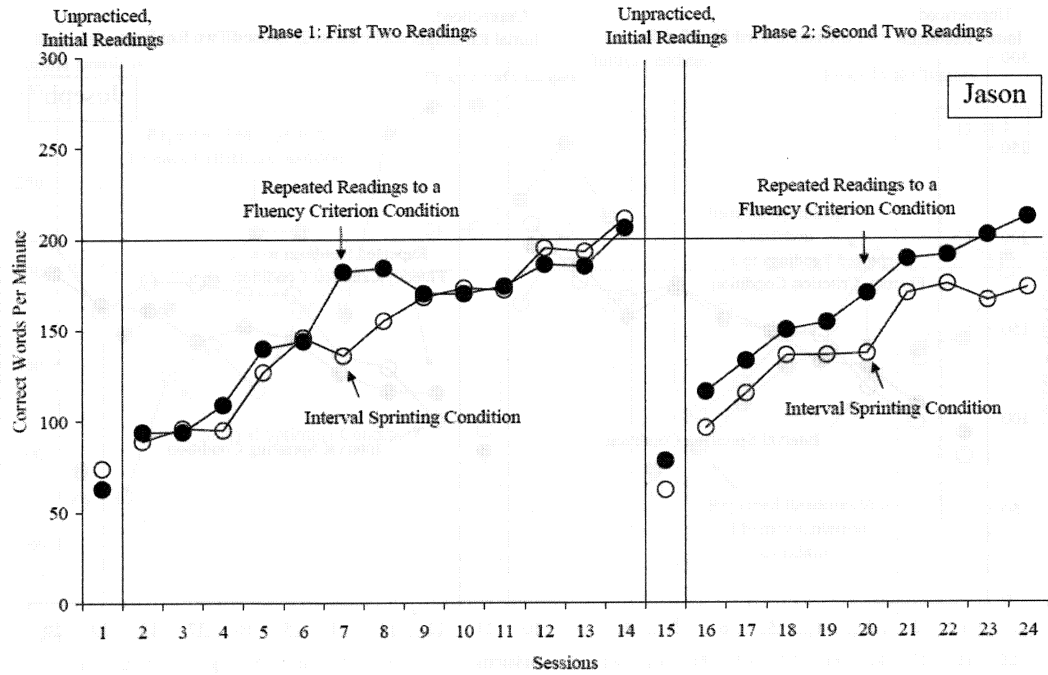
Figure 3. Correct amd Incorrect words per minute read by Jason across both conditions and phases

Joseph read 209 correct with 1 error during the 9th session. Meeting criterion first under the RRFC condition, Brad read 229 correct with 2 errors during the 13th session. While both Joseph and Jason did not exceed 200 correct words per minute until the session they met criterion, Brad surpassed the 200 correct per minute word mark during the 4th session. Although, he still read with an average of 13 incorrects per minute with a range of 7-17. Not including the session where he met criterion, Brad read 200 words per minute or more during seven sessions under the RRFC condition and three times under the IS condition. However, he did not drop below six errors in either condition until meeting criterion during the 13th session. Brad continued to make the same errors regardless of error correction and feedback. Similar to the Staubitz et al. (2005) study, a change to the procedures appeared necessary. While Staubitz et al. lowered the timing from 60 to 20 seconds to assist a participant in reaching the fluency criterion; Brad could not have a lowered time interval and maintain the integrity of comparisons with other participants. Therefore, the experimenter made two changes to the procedures for Brad after the 11th session.

For the first change, the experimenter adjusted Brad's accuracy criterion from 99% (i.e., 200 or more correct and 2 or less incorrect) to 98% correct provided he read more than 200 words correct per minute. For the second change, the experimenter highlighted 10 high frequency errors on each of the two passages. Brad then read from these highlighted passages during the first 2 minutes of each condi-

tion. During the test in each condition, however, the experimenter removed the highlighted copy and had Brad read from a clean copy of each passage. The experimenter made these changes prior to the 11th session. Brad reached the fluency criterion three sessions later.

The data paths of correct words read per minute for Brad (Figure 1) overlapped during only one session with RRFC condition outperforming the IS condition showing a strong separation. The data paths of correct words per minute for both Jason (Figure 2) and Joseph (Figure 3) showed very little separation. Errors for Brad not only appear variable, but also overlap 40% of the time (Figure 1), while errors for Joseph decreased steadily in both conditions (Figure 2). Jason's data show an increasing trend of errors within the RRFC condition while errors in the IS condition maintained low levels (Figure 3). Towards the end of the 1st phase, Jason made more errors as he read the RRFC passage faster.

On average, each participant had 22.6 minutes of reading practice for the two conditions (i.e., two minutes per condition, two conditions per session, ranging from 9-13 sessions for an average of 11.3 sessions). During the RRFC condition, the participants read an average of 169 (range 151-203) correct and 4 (range 2-9) incorrect words per minute. The participants read an average of 186 (range 169-215) correct and 7 (range 4-11) incorrect words per minute during the IS condition. Participants read an average of 17 more words correctly and 3 more incorrectly in the IS condition in an identical amount of reading time.

Second Phase. Unlike the 1st phase, two of three participants met fluency criteria on the passage in the RRFC condition first. Brad met the fluency criterion during the 22nd overall session, or the 8th session within phase 2, with a score of 206 correct and 4 incorrect per minute (i.e., 98% correct with more than 200 correct words per minute). Jason took 9 sessions, or the 24th overall session, to read 212 correct with 2 errors. Joseph, reaching criterion in the IS condition first, read 200 correct with 1 error during the 9th, or 20th overall, session. When comparing number of sessions, each participant met criteria as fast as or faster than the 1st phase by an average of approximately three sessions.

Similar to the 1st phase, both Joseph and Jason read 200 or more words correctly only in the session they met criterion. Unlike the 1st phase, Brad read more than 200 correct words per minute twice other than the session he met criteria. Even though Brad had fewer incorrects during both conditions in the 2nd phase, he again started to make consistent errors regardless of error correction. To minimize the frustration Brad experienced during the 1st phase and maintain uniformity, the experimenter highlighted five words consistently read incorrectly on both passages prior to the 20th session and maintained the same accuracy criterion (i.e., 98% correct).

The data paths during the 2nd phase showed more separation across participants compared to the 1st phase. For Brad and Joseph, the reading scores during the IS condition outperformed the RRFC condition in all but two sessions each showing a moderate separation. Jason's data show the opposite. His data paths (Figure 3) display a strong separation as he read more correct words each session during the RRFC condition. Brad (Figure 1) and Jason (Figure 3) demonstrated stable, variable errors across the phase. After a jump in error frequency, Joseph's data again showed the downward trend apparent in the previous phase (Figure 2). All participants decreased average errors per minute from 5 to 3.4 during the RRFC from the 1st to 2nd phase. Participant averages during the IS condition showed a slight increase (i.e., 4.2 to 4.5) in errors from the 1st to 2nd phase

On average, each participant had 17.3 minutes of reading practice for the two conditions (i.e., 2 minutes per condition, two conditions per session, ranging from 8-9 sessions for an average of 8.6 sessions). During the RRFC condition, the participants read an average of 148 (range 143-158) correct and 4 (range 2-6) incorrect words per minute. The participants read an average of 177 (range 170-183) correct and 6 (range 3-6) incorrect words per minute during the IS condition. Participants did read less total words per minute from the 1st to 2nd phase (i.e., RRFC, 169 to 148, and IS, 186 to 177). However, participants averaged more words during both IS condition compared to both RRFC conditions. Participants read 17 more correct and 3 more incorrect during the 1st phase compared to 29 more correct and 2 more incorrect during the 2nd phase.

Social Validity

All participants stated that they enjoyed

taking part in the study. Some of the responses indicated that they liked reading to the experimenter and reading quickly and accurately. Each of the participants preferred the RRFC condition to the IS condition and only one of the three participants said the IS condition helped him more. The other two felt the RRFC condition helped them more.

Each parent reported feeling their child benefited from the study and noticed some specific changes in their behavior. The parents commented that their children seemed more motivated to read, didn't get bored or distracted when reading, and had fun. Also, each parent responded that they would use both procedures at home and would like to see them used at school.

In addition to the questionnaire, some parents provided unprompted information relevant to the study. One parent explained that his child now reads television captions aloud accepting error correction. As the study progressed, another parent expressed that her child started to read aloud daily. Another parent noted how his child used to dislike the "buzz" from the timer and could not stand timed readings. He went on to say that his child now liked reading with a timer and telling them how many words he read.

Discussion

This study compared repeated readings to a fluency criterion (RRFC) with interval sprinting (IS). The experimental question asked which of the two procedures facilitated attainment of the fluency criterion of 200 or more correct words per minute with 2 or less errors. The data sug-

gest little difference between the methods as participants met criterion under both procedures an equal number of times. Additionally, the data paths contained within the alternating treatment design, while showing strong separation during isolated phases, did not produce consistent differences across participants presenting unclear differences between the two procedures.

One possible reason for the similar results may derive from on the practice-to-test timings. Participants reading in the RRFC condition practiced and tested on the same one-minute metric. In order to draw balanced comparisons, participants reading in the IS also tested for one-minute never having the opportunity to practice the passage for one minute. Therefore, their one-minute assessment scores may have represented the fastest they could have read that session for one minute regardless of condition given three factors. First, participants read grade-level equivalent passages. Second, participants read approximately the same number of words per minute each test session. Third, both procedures reported effective gains.

The almost equal, yet effective results mirror the findings from other studies reporting repeated readings to a fluency criterion gains (e.g., Staubitz et al., 2005; Therrien & Kubina, 2007; Yurick et al., 2006). These results systematically replicate and extend the literature base for RRFC and also provide preliminary support for the effectiveness of the IS procedure.

During the 2nd phase, both methods contributed to higher average initial reading scores and all participants reached

criterion in the same or fewer number of sessions to criterion in the 2nd phase. This finding provides support for the assertion that RRFC and IS lead to transfer in other passages (Faulkner & Levy, 1994). Samuels (1979) first observed this phenomenon with repeated reading: higher initial reading scores on successive passages and shorter amounts of time to criterion. Rashotte and Torgesen (1985) found transfer occurred once 50% of the words overlapped between passages. Faulkner and Levy (1994) noted that for poor readers content or words needed to overlap with overlap defined as approximately 72% of shared words. The passages in the current study had no content overlap and relatively low word overlap (i.e., approximately 30%), yet the participants displayed meaningful transfer during the 2nd phase. Reading transfer for these participants may have resulted from one or a combination of factors within the study: High fluency criterion (i.e., 200+ words per minute), practicing at a high criterion for correct words per minute with a low error criterion (i.e., 2 or less errors), and/or the synergy of two effective fluency procedures.

The majority of reading fluency studies had students typically read at rates lower than 200 or more correct words per minute. For example, Rashotte and Torgesen (1985) reported mean word per minute increases from 54 to 90 in one condition and 57 to 90 in the other condition over four readings. Faulkner and Levy (1994) did not display first passage times, but reported reading times for the transfer passage. Looking at poor readers in 6th and 3rd grade, mean word per minute rates calculated to a range of 72 to 100 for poor readers in 3rd and 6th grades across all conditions. Participants reaching fluency criterions of 200 or more correct words per minute may need neither word nor content overlap to display transfer.

The rate of 200 words per minute used in the current study, especially for 2nd and 4th graders, exceeds most of the rates published in previous research. For example, in their review of repeated readings, Meyer and Felton (1999) reported desirable oral reading word rates for 2nd graders at 85 to 115 words per minute and 120 to 150 for 5th graders. Hasbrouck and Tindal (2005) published similar mean scores of 89 words per minute for 2nd graders and 125 for 4th graders. With respect to the score of 200 words per minute, Hansbrouk and Tindal reported that rate as a 90th percentile reading score for 6th graders while Meyer and Felton state 200 words per minute as a mean high school silent reading rate. This study showed that participants with or at risk for reading disabilities reached an oral reading rate of 200 words per minute after only an average of 33 minutes of practice during the 1st phase and 24 minutes of practice on during the 2nd phase with grade level material. Therefore, setting a high fluency criterion not only seems feasible, but also demonstrated the positive effect of transfer to new reading passages with low word overlap and no related content.

Another factor possibly contributing to transfer involves participants consistently practicing to not only a higher frequency of words read per minute, but the inclusion of a very high accuracy criterion.

Previous researchers (Staubitz et al., 2005; Yurick et al., 2006) had students reach rates of 145 words per minute with 10 or fewer errors for 4th graders to a range of 145-180 words per minute with 10 or fewer errors for 5th graders. Therefore, at minimum, these students met criterion with 93-95% accuracy. In the current study, 2nd and 4th graders reached criterion with minimum 98-99% accuracy. Obtaining fluency, or what Binder (1996) calls true mastery or behavioral fluency, with a high oral reading rate may help positively shape reading performance. These new patterns of reading performance, once learned, may have resulted in a more careful and sharpened approach to decoding text thereby promoting students' reading transfer between unlinked passages.

The third factor connected to reading transfer may have resulted from the synergy of the two effective fluency building procedures. Considering the effectiveness of the previously mentioned two factors, each student may have benefited from experiencing each condition every session. This also may explain why neither method distinguished itself through the alternating treatment design.

Focus on Interval Sprinting

All three participants demonstrated endurance with oral reading during the interval sprinting procedure. Each participant practiced reading for a series of 10-second timings then read for one minute. The one-minute assessment constituted an unpracticed, much longer reading time. In previous examples (Bourie, 1980; Desjardins, 1981) and dis-

cussions (Binder, 1996) of endurance building, "sprinting" referred to achieving high rates of accurate behavior for short intervals of time, then lengthening the intervals (Binder et al, 1990). During the IS condition, participants never practiced for longer than 10 seconds consecutively per timing yet displayed one-minute test scores equal to those during the RRFC condition. By distributing the 10-second sprints throughout the passage, participants showed that they could read as well for one minute with the added benefit of covering more words during practice.

The additional word practice resulted from participants routinely reading above rates of 34 words per 10 seconds or more than 204 words per minute. This, as mentioned earlier, allowed students to make more efficient use of the allocated practice time. The inclusion of additional IS practice passages across time may have shown the results of this reading productivity. Using the average increase of words during the two phases (23) and extrapolating over 150 school days, students could practice 3,450 more words (i.e., almost 14 typed, double-spaced pages) given the same practice time. In the context of cumulative practice, especially under guided practiced conditions, students may find future performance affected by practicing a few additional words daily (i.e., more correct reading leads to more correct reading).

To experimentally balance the IS and RRFC conditions, the experimenter limited feedback within the IS procedure to two specific places, after the 6th and 12th sprints. When applied in practical situa-

tions, practitioners would not withhold error correction and feedback until these points. With the IS procedure, teachers have the opportunity to provide 12 distinct periods of feedback and error correction (i.e., after each sprint) compared to the 2 used in the present experiment. Such feedback could conceivably reduce student errors more quickly, fostering high quality practice sessions.

Social Validity

Each student stated they preferred the RRFC over the IS condition. The students' comments fall in line with the matching law (Hernstein, 1997; Martens, 1992). The matching law states that when confronted with a choice, people will chose those behaviors that meet with the most reinforcement (Martens). Therefore, fluent readers may like to read passages and for longer periods of time, relatively speaking. These instances of reading allow the reader to meet with more success (i.e., reinforcement). One-minute timings consist of more continuous opportunities to read as compared to 10 seconds of reading. Additionally when presented with 12 tasks (i.e., 10-second trials) versus 2 tasks (i.e., one-minute trials), it seems better to choose the lesser one.

Study Limitations

The following limitations in the study require attention. First, the varying order of practice sessions and calculation of word overlap helped control for some confounds associated with an alternating treatment design, but not all. The presentation of only one of the two practice procedures per ses-

sion alternatively would have helped control for carryover effects. Second, the omission of a control condition presents another limitation. The possible separation between data paths for a third condition (i.e., reading a passage silently or aloud for 2 minutes) and the other two conditions may have better highlighted IS and RRFC gains. Also because two participants read the same four passages, simply varying the presentation order of those four passages may have further demonstrated experimental control.

A third limitation for this study involves the format of materials during the IS condition. The word total numbering system on each experimenter copy represented a running total of words rather than a per line measure. This greatly assisted tallying one-minute reading scores, but did not help when counting 10-second sprints. The experimenter had to manually count words read during sprints, artificially increasing the time between sprints or adding overall time to the IS procedure. Simply changing the numbering system would have decreased pauses.

Future Research Directions

Based on the results of this study, the interval sprinting procedure warrants further examination. One such examination could consist of exploring the relationship between reading transfer and high fluency criterion measures used with the IS procedure as the only condition. Maintaining a criterion of 200 correct and 0-2 incorrect words per minute, research may also test the IS procedure with both older and younger children with varying dis-

abilities. Passage type may also vary. For example, this study displayed the effect of the IS procedure with stand-alone passages. Future research can also examine whether more interval sprints per passage (i.e., three to four rather than two) may facilitate students reaching the criterion more quickly and increasing transfer.

Conclusions

Almost 25 years ago, Allington (1983) suggested that building oral reading fluency helps create "effective and efficient readers" (p. 561). Methods that build fluency should meet the same effective and efficient criteria. The data presented in this study suggest interval sprinting leads to the attainment of oral reading fluency in children with or at-risk for reading disabilities. Using 10-second practice trials, interval sprinting not only mirrored the results when participants used repeated readings to a fluency criterion, but participants displayed more reading production given the same reading time. With the ever increasing importance placed on effective and efficient fluency building procedures for reading, interval sprinting may prove a valuable addition to the continuum of fluency-building practice procedures.

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