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Why Do Some Students Do Poorly?

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Comprehension and Rate During Silent Reading: Why Do Some Students Do Poorly?

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Abstract

This exploratory study was designed to evaluate the interplay of students' rate and comprehension in independent silent reading of accessible text, within the frameworks of the Simple View of Reading and the RAND Reading Study Group. In the first phase, 61 sixth graders were given a reading test (GRADE), a motivation questionnaire, and an on-screen measure of comprehension-based silent reading rate (SRF-O, adapted from aimswebPlus SRF) with on-grade and below-grade text. Two-thirds of students had perfect or near-perfect SRF-O comprehension, but the other one-third had moderate to poor comprehension. These weaker SRF-O comprehenders had relatively low GRADE scores, but others with comparable GRADE scores comprehended well on SRF-O. The poorest SRF-O comprehenders read with increasing rate and decreasing comprehension across the SRF-O texts. In the second phase, the 21 students with weaker SRF-O comprehension took an oral reading fluency (ORF) test and a paper form of the silent reading rate measure (SRF-P) in a one-on-one setting. All students comprehended well on SRF-P and their SRF-P rates correlated highly with GRADE and ORF. Results support the view that poor comprehension in independent silent reading of accessible text may be due to factors other than reading ability (such as assessment context) and that, when students read with comprehension, their rate is a good indicator of their reading ability.

Keywords: silent reading fluency, reading comprehension, oral reading fluency

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Why Do Some Students Do Poorly?

The goal of reading instruction is for students to read with comprehension. In assessment contexts for school-age students and in the majority of reading done by adults, comprehension is established from individuals' responses following silent reading of texts. Findings of a relatively strong correlation between oral reading fluency (ORF) and comprehension on silent reading assessments (Reschly, Busch, Betts, Deno, & Long, 2009) have led to an emphasis on improving ORF rates during the elementary years (Rasinski, Reutzel, Chard, & Linan-Thompson, 2011). However, while SRF and ORF have constructs in common (Van den Boer, van Bergen, & de Jong, 2014), SRF is not simply ORF in a different modality. ORF reflects rate of recognizing and producing words and does not typically assess the level of text comprehension. By contrast, SRF has no oro-motor component and usually has a comprehension component.

There is evidence that increased time spent in ORF experiences in elementary schools has not led to improvement in silent reading comprehension. Over the past decade, comprehension in silent reading has stayed relatively flat (Lee, Grigg, & Donahue, 2007; National Center for Education Statistics, 2018), while oral reading rates of students at the 50th percentile in grades 1 through 5 have increased by an average of 8 words per minute (Hasbrouck & Tindal, 2006, 2017). Furthermore, a study conducted in the United States in 2011 with a national sample of students in grades 2 through 11/12 showed that rates of reading silently with comprehension had declined since 1960 at grades 4 and above (Spichtig et al., 2016). A better understanding of silent reading rate and its relationship to comprehension is required if appropriate instruction that aids students in silent reading performance is to be provided to the substantial portion of a grade cohort that fails to attain even basic levels on national reading comprehension assessments.

The program of work, as represented by the study in this paper, is focused on applying a theoretical framework to the relationship between rate and comprehension in silent reading. In this study, the framework was used to try to untangle a phenomenon that has been identified in several studies on rate and comprehension where a portion of the sample comprehends poorly but reads more rapidly than peers (Hiebert, Wilson, & Trainin, 2010; Trainin, Hiebert, & Wilson, 2015) Data on silent reading rate are not useful unless data on comprehension are captured appropriately. Consequently, this study was designed to apply the theoretical framework to understand less-than-efficacious patterns of rate and comprehension in a silent reading assessment.

We begin by reviewing the studies that have shown that a portion of a cohort displays poor comprehension and often relatively rapid reading. These studies are descriptive in nature and were not guided by a strong theoretical framework. Following the summary of these studies and their findings, we describe the theoretical framework that underlies the current study and the elements of this framework that were of focus in addressing the phenomenon of poor comprehension/rapid reading rates.

Research on Poor Comprehension/Rapid Reading Rates

At the present time, assessments of silent reading comprehension rarely provide information about reading rate. That is, the scores from standards-based or norm-referenced assessments indicate the accuracy of students' responses to comprehension questions but do not give insight into the rate at which students read the passages. By contrast, measures of silent reading rate address comprehension, but they do so in diverse ways. They may provide information on rate in relation to recognizing individual words (e.g., the slasher test for unconnected words; Mather, Hammill, Allen, & Roberts, 2004), intra-sentential comprehension (e.g., sentence verification; Wagner, Torgesen, Rashotte, & Pearson, 2010; maze; Good, Kaminski, & Cummings, 2011; Shinn & Shinn, 2002), or comprehending paragraphs or longer

pieces of text (e.g., underlining; Price, Meisinger, D'Mello, & Louwerse, 2012). Furthermore, on most of these assessments of silent reading rate, the tasks do not require sustained reading. That is, putting a line between two words (slasher test) or picking one of three choices every seven words (maze test) does not require students to be monitoring their ongoing understanding of a text. Or, if readers are allowed to look back at the text, students may be aware that they do not need to monitor their comprehension carefully.

Only a small group of studies has examined SRF in the setting where students read intact text and then demonstrate comprehension without rereading. This paradigm is referred to as *comprehension-based silent reading rate* (CBSRR; Hiebert, Samuels, & Rasinski, 2012) because the construction of meaning occurs while students are reading. In these studies, the rate score (based on time spent reading text) is conditional on satisfactory comprehension. Unlike the slasher, sentence verification, and maze tasks, the use of intact passages and follow-up questions more closely mirrors the typical task of assessments, at least those where students cannot revisit the text.

Studies using the CBSRR approach have shown a consistent pattern: A group of students fails to employ reasonable reading rates and also performs poorly on the comprehension questions that follow the texts. The two largest studies using this paradigm employed the same set of texts, the first in 1960 (Taylor, 1965) and the other in 2011 (Spichtig et al., 2016). The samples in these studies extended from grades 2 through 11 or 12. The Taylor study, with about 6,400 students, did not report the number who failed to attain adequate comprehension, but the Spichtig et al. study of about 2,000 students showed that, on each passage, about one-third failed to meet a liberal criterion for comprehension (answering seven of ten true/false questions correctly), and 9% did not reach this threshold on any of four passages.

A second line of research using the CBSRR paradigm, similar to the Spichtig et al. study, has shown patterns of high reading rates among students who fail to attain a comprehension criterion (Hiebert et al., 2010; Trainin et al., 2015). Hiebert et al. found that 22% of the fourth graders in the sample had poor comprehension and high reading rates. In this study, 83 fourth graders read two 1,000-word expository texts, each divided into five sections. Students read one text on-screen in a group setting and the other on paper in a one-on-one setting where the observer recorded times. Immediately after reading each section, students answered four four-choice comprehension questions. Rate was slightly but significantly higher with onscreen presentation, but there was no difference in comprehension (average comprehension accuracy of 53%). After the first or second sections of text, students with below-average comprehension doubled or tripled their silent reading rates, in contrast to the good comprehenders who maintained stable rates across the five sections.

Trainin et al. (2015), using the same texts as Hiebert et al. (2010), had 140 fourth-grade students read one text orally and the other silently; both were presented on-screen and in one-on-one sessions. They also administered the *Gates-MacGinitieReading Test* (G-M; MacGinitie, MacGinitie, Maria, & Dreyer, 2007). Comprehension was slightly lower in the silent than the oral mode. Further, silent reading rate was inferior to oral rate in predicting comprehension on the G-M (r = .45 and .76 respectively) or on the questions associated with the text (r = .20 and .70). Students in the lowest quartile on the G-M had highly variable silent reading rates, with a standard deviation about 40% greater than in the other quartiles and nearly three times as great as for oral rate. Students in the lowest quartile in oral reading rate appeared to make a speed-comprehension tradeoff during silent reading, in that their rate correlated -.41 with their accuracy on the questions that followed the text.

In sum, the existing research shows that a portion of a cohort fails to attain criterion comprehension levels in assessments of silent reading comprehension. On average, the students with poor comprehension read at more rapid rates than peers with higher comprehension or than would be anticipated by grade-level silent reading norms (e.g., Spichtig et al., 2015).

Applying a Theoretical Framework to the "Poor Comprehension/Rapid Reading" Problem

The relationship between the rate at which readers recognize words in text and their construction of meaning is a complex one. Understanding the role of rate in silent reading comprehension, we argue, requires integration of two theoretical perspectives that have typically been examined in distinct research literatures: (a) the Simple View of Reading (SVR; Gough & Tunmer, 1986) that describes the relationship of word recognition and linguistic comprehension to readers' comprehension of text and (b) the model of the Rand Reading Study Group (RRSG; Snow, 2002), in which the interaction of reader and text is viewed in relation to the activity or purpose for reading and the context in which reading occurs. The integration of these two frameworks ensures that the sources for poor comprehension/rapid reading can be investigated comprehensively. Greater attention can be given to readers' word recognition and comprehension processes within this integrated framework than typically occurs within applications of the RRSG model. Furthermore, the processes related to word recognition and comprehension can be viewed in relation to variables that are often not in the foreground in studies of the SVR model—text, activity, and context. Additionally, the RRSG model broadens the view of the reader to include aspects related to motivation and engagement. That is, the manner in which students' affect may influence their application of word recognition and comprehension processes becomes a focus. The manner in which the elements of this integrated

framework permit a thorough investigation of the poor comprehension/rapid reading phenomenon is described in the following overview.

Reading as an interaction of word recognition and linguistic processing

The SVR addresses readers' word recognition proficiency and linguistic processing in relation to comprehension. The inability of readers to recognize the meanings of words rapidly has long been recognized as an impediment to comprehension (Huey, 1908; LaBerge & Samuels, 1974; Perfetti, 2007). Without automaticity in recognizing the meanings of the vast majority of words in a text, the reader's attention is diverted from constructing meaning of the text.

When the construct of automaticity in reading was proposed, it was in relation to silent reading (Huey, 1908; LaBerge & Samuels, 1974). For several reasons, however, ORF has been given substantially more weight than SRF in reading instruction and assessment. First, ORF is relatively easy to measure. Second, ORF has been found to correlate reasonably strongly (around 0.6) with SRF (Denton et al., 2011; Reschly et al., 2009). Third, speed of silent reading in itself (especially when self-monitored or reported by students) is meaningless without information on comprehension, which can be challenging to measure.

What precisely the relationship between ORF and comprehension in silent reading represents, however, is uncertain. The typical view is that the students who are less than automatic in recognizing words (as captured by ORF) are also less automatic in recognizing words in silent reading contexts, leaving them with less cognitive capacity to process content. This interpretation may explain poor comprehension for some students, but other explanations can also be offered. For example, on timed assessments, some students may perform adequately on the portion of the assessment that they complete but may not be able to complete the entire assessment. Another possibility is the one reported by Hiebert et al. (2010) and Trainin et al.

(2015) where students in the bottom quartile based on comprehension scores performed adequately at the beginning of the assessment but then began to read rapidly or not at all.

Without an understanding of the patterns of reading behavior in which students engage during silent reading, instructional solutions are difficult to design. For example, an intervention to increase automaticity through oral reading fluency activities may not address the inability of students to monitor their comprehension in silent reading contexts or to sustain a consistent reading rate over an extended text. The degree to which automatic word recognition and linguistic processing characterize performances of students who display the pattern of poor comprehension and, typically, rapid reading rates needs to be established, if appropriate instructional solutions are to be provided.

Reading as a function of reader, text, activity, and context

In the framework of the RRSG (Snow, 2002), the interaction between reader and text is viewed in relation to the activity (that is, the purpose or use of reading) and the context in which the reading act is occurring.

Context and activity. The nature of the activity and the context of the reading act, which are critical considerations when examining reading outcomes and the variables that influence those outcomes, typically differ between silent and oral reading assessments. During oral reading, if students stop reading, the monitor (either an adult or a digital algorithm) is likely to prompt them to continue or even provide the next word. In many curriculum-based assessments of oral reading, the focus is on speed and little attention is paid to prosody or comprehension. Thus, if students have not been attending to meaning, the consequences may be minimal. The context and activity of silent reading differs considerably from those of oral reading. In silent reading, students typically know that they will need to provide evidence that

they have understood the text, making them responsible for monitoring their understanding. The self-direction inherent in silent reading, especially when students are aware that they cannot revisit the text to answer questions, makes factors such as the nature of the task and the context of reading central considerations in understanding students' reading performances.

An aspect of reading context that has become increasingly salient with the prevalence of digital devices is whether the text is on a computer screen or on paper. Research comparing comprehension and rate in the two formats has had mixed findings. Research on "screen inferiority" (i.e., poorer comprehension when reading on screen than on paper) suggests that people may read less systematically and more superficially on screen (Lauterman & Ackerman, 2014). However, in their review of research since 1992, Singer and Alexander (2017) concluded that, when texts were short (less than 500 words), comprehension was as good or better in the digital format as on paper. The study within the CBSSR literature (Hiebert et al., 2010) that compared students' performances in a digital and a paper-and-pencil measure found no format difference in comprehension, although rate was higher in the on-screen than paper presentation.

The act of taking a reading test involves not only the activity of reading but also the activity of performing a comprehension task, and these tasks vary across tests. For example, the activity of completing modified cloze questions differs from the activity of reading an intact passage and then answering comprehension questions, especially when the option to return to the text is not given. Different comprehension tasks place different levels of processing demands on students. For example, answering questions embedded throughout a paragraph as in a maze assessment is different from answering a question after several sentences.

The current study did not manipulate the comprehension tasks, but rather used a consistent follow-up activity designed to maximize engagement by all students, including less-proficient readers.

This comprehension check was similar to that used in Carver's (1982, 1983) research on rate. Carver used comprehension questions that were aimed at determining whether students were getting the gist of the text, rather than assessing students' abilities to recall details, to make higher-level inferences about the text content, or to make connections across texts. This type of comprehension task serves to show whether students engage in meaning-making while reading. The materials used in the current study also resembled Carver's tasks in that the text segments were relatively short, so as not to burden memory. When students cannot look back at the text, a series of brief passages, each followed by one or a few questions, is preferable to a longer passage followed by multiple questions.

Text and reader. The complexity of the text is a critical consideration when analyzing the phenomenon of poor comprehension and rapid reading. From their review of 26 studies, Amendum, Conradi, and Hiebert (2017) concluded that increasing the level of text challenge typically reduces oral reading rate and, less consistently, results in poorer comprehension. In order to learn about the relationship between rate and comprehension, it is valuable to use texts that are accessible for the less-proficient students. If the text is beyond students' ability to comprehend even with effort, students may be less likely to engage in reading. Without engagement, the measure is not a very valid one; the construct of CBSSR assumes comprehension. However, as already noted, previous studies of rate and comprehension such as those of Spichtig et al. (2016) and Trainin and colleagues (Hiebert et al., 2010; Trainin et al., 2015) used texts at the challenging levels considered necessary for college-and-career readiness. In these studies as already reported, a substantial portion of students failed to reach lenient comprehension criteria. Therefore, the current study can bring a new perspective to the issue of poor comprehension/rapid rate by using more accessible text. At the same time, the manipulation of text complexity could show whether the comprehension and reading rates of reluctant readers are sensitive to text complexity. That is, do students who show the poor comprehension/rapid reading pattern display

this propensity regardless of text complexity?

The RRSG model also encompasses the reader characteristic of motivation, which has long been identified as an explanation for poor comprehension. Numerous constructs have been identified as representing motivation, including students' interest in different topics (Hidi & Renninger, 2006), views of competence (Elliot & Dweck, 2005), and emotions such as hope and anxiety (Pekrun, Goetz, Titz, & Perry, 2002). The most comprehensive model of motivation related to reading performance is that of Wigfield and Guthrie (1997, 2000). Four constructs identified by Guthrie, Hoa, Wigfield, Tonks, Humenick, and Littles (2007)–curiosity, preference for challenge, involvement, and efficacy–have been shown to be robust, predicting the amount and breadth of reading (Wigfield & Guthrie, 1997), reading comprehension test performance (Guthrie et al., 2007), and participation in and comprehension of lessons (Guthrie, Wigfield, Humenick, Perencevich, Taboada, & Barbosa, 2006). A topic that has not been explicitly investigated is the relationship of motivation to the rates at which students read silently with comprehension.

The Current Study

This study investigated the influence of several student, task, and context variables on the comprehension and rate of sixth-grade students on a SRF assessment. In order to focus specifically on those students who display poor comprehension and rapid reading, a two-part design was used. The first part of the study evaluated the effects of reading ability, text complexity, and reading motivation on silent reading rate and comprehension in a typical group of students. A purpose of this phase of the study was to identify the students who display poor comprehension/rapid reading. This phase of the study also made it possible to compare the

performances of poor comprehenders with those of their more proficient peers on measures of general comprehension, text complexity, and reading motivation.

The second part analyzed in greater detail the effect of these factors along with ORF and assessment context (independent, onscreen administration vs. one-on-one administration with paper materials) on the silent reading behaviors of students who comprehended poorly in the first part. The study addressed the following questions:

1. How do reading ability, text complexity, reading motivation, and assessment context affect comprehension and rate on an SRF measure?
2. How does the level of comprehension during silent reading affect rate and the validity of rate?
3. Does the rate and/or comprehension of poor comprehenders change during the testing session?

Method

Participants

The 61 students (31 males and 30 females) came from five sixth-grade classrooms in a public school in a town near an urban cluster in the southeastern United States. The school's ethnic distribution is similar to that of the nation: 21% African American, 15% Hispanic, 56% White, and 8% other; 47% of the school's students are eligible for free/reduced lunch. Parent consent was obtained for all participants. Initially, 74 students participated in Session 1, but 13 were excluded because of missing data on overall reading assessment or the on-screen SRF test.

Materials

The study used a combination of group and individually administered measures to assess reading ability, silent and oral reading rate, and reading motivation.

Silent reading fluency measures. The two measures of SRF follow the CBSRR model in that students silently read brief pieces of text at their own pace and then answer questions about gist without being able to look back. They were specially adapted versions of *aimswebPlus Silent Reading Fluency* (aimswebPlus SRF; Pearson, 2015), an on-screen measure which captures rate conditional on adequate comprehension. We will first describe aimswebPlus SRF and then explain how it was adapted to serve the purposes of this study.

The aimswebPlus SRF. This test is designed to measure the rate of reading grade-level narrative text with comprehension. It has 20 forms at each grade from 4 to 8. The content of aimswebPlus SRF consists of texts (stories) of approximately 150-170 words that were written to be on grade level according to the Pearson Reading Maturity Metric (Landauer & Way, 2012), a complexity index based on vocabulary, syntax, and coherence. On the Lexile scale, which is based on sentence length and vocabulary, the sixth-grade texts are easier than the level recommended as adequate for grades 6 to 8 by the Common Core State Standards for ELA/Literacy, Appendix A (National Governors Association & Council of Chief State School Officers, 2010). The texts are below the 25th percentile of reader Lexile measures at each grade (Lexile Framework for Reading, 2018).

An aimswebPlus SRF form contains three texts. Each text is divided into four segments of 35 to 45 words, and each segment is followed by a comprehension question. Brief segments are used to reduce memory demands and increase the number of independent rate measurements. Directions consist of two sample segments and questions, followed by instructions to work quickly but carefully since students will not be able to look back to the text when answering questions. After reading each segment, students click the Next button and see a new screen with a three-option question about that segment. Questions were designed to determine whether

students understood the gist. After answering, students again click Next, get feedback on whether the answer was correct, and see the next segment. At the end of each four-segment text, students are told how many answers were correct and are urged to answer at least three correctly on the next text.

The rate score for each text is the median WPM on the four segments. The overall aimswebPlus SRF score is the average of these text WPMs, but is reported only if the student answered at least 3 of 4 questions correctly on at least two texts. This requirement is based on the fact that silent reading rate is meaningful only if students are reading for comprehension. In that aimswebPlus SRF questions typically are answered correctly by about 90% of students (Pearson, 2015), this criterion of 75% correct can be viewed as lenient. The aimswebPlus SRF was nationally normed in 2013-14 on a representative sample of 12,000 students in grades 4 to 8. Alternate-form reliability at grade 6 was .86 (Pearson, 2015).

Adapted SRF measures. Two modified versions of aimswebPlus SRF were used in this study in order to evaluate the effects of text complexity and administration context. Both measures used content from aimswebPlus SRF. One of them ("SRF-O") used the aimswebPlus SRF software platform to administer the measure on-screen to students working independently, and the other ("SRF-P") was administered on paper in a one-on-one session with an examiner.

The first modification incorporated in the SRF measures was a change in the number and complexity level of texts administered. Six texts were included in SRF-O and four in SRF-P. On each measure, half of the texts were on grade level, drawn from the Grade 6 portion of the aimswebPlus SRF corpus of texts, while half came from the Grade 4 portion. The texts were presented in alternating sequence of complexity, starting with a Grade 4 text.

The texts within a grade level were chosen to be close to one another in Lexile value. Minor modifications were made to decrease variation in Lexile levels within a grade level, which had the effect of increasing the difference between levels (Table 1). Care was taken so that edits affecting sentence length (the more influential variable in the Lexile Framework algorithm; Deane, Sheehan, Sabatini, Futagi, & Kostin, 2006) did not remove connectives that can facilitate comprehension (Pearson, 1974). The modifications to vocabulary, an influential variable with respect to comprehension (Ouellette, 2006), included replacing rare names (e.g., *Matteo)* with more common names (*Luke*) and replacing a few words with more or less challenging synonyms. Table 1 shows that these modifications had the desired effect of decreasing variation of the texts within a grade-level group, while maintaining distinct differences between the two levels in vocabulary.

The second modification was to create the paper-based SRF-P for one-on-one administration. To be compatible with the SRF-O presentation, each SRF-P segment and each question were printed on a separate page, and students moved through pages in a manner similar to advancing through computer screens. Students were not permitted to look back when answering a question. They responded to each question by saying the letter of their choice, which the examiner recorded as well as the time of each page turn. The examiner gave accuracy feedback at the end of each four-segment text, but not after each question as in the SRF-O administration.

SRF-O and SRF-P were comparable in question difficulty as measured by the proportion of the national standardization sample answering each question correctly. Question *p* values averaged .90 on both SRF-O (*SD* = .05) and SRF-P (*SD* = .04).

Reading ability measure. The *Group Reading Assessment and Diagnostic Evaluation* (GRADE; Williams, 2001) is a norm-referenced, group-administered, paper-and-pencil reading assessment. For this study, students took the Vocabulary, Passage Comprehension, and Listening Comprehension subtests. We used the Total score (prorated from the sum of Vocabulary and Passage Comprehension) in the analyses because it is the most reliable score and because it reflects the broad construct of reading ability as typically defined on reading batteries and state assessments, which are the criteria that progress-monitoring tools such as ORF and aimswebPlus SRF attempt to predict. The Total score is a grade-based standard score ($M = 100$, $SD = 15$). Listening Comprehension scores were converted to the standard-score metric for ease of interpretation.

Motivation for Reading Questionnaire (MRQ). Students completed an 18-item version of the MRQ (Wigfield & Guthrie, 1997) that included four scales: Efficacy (reading ability), Preference for Challenge (willingness to read difficult text), Curiosity (reading to learn about things of interest), and Involvement (connecting with story and character). Students rated each statement from 1 (Very Different from Me) to 4 (A Lot Like Me), and the score for each scale was the average rating.

Oral Reading Fluency (ORF). Students took the standard Grade 6 fall benchmark form of aimswebPlus ORF (Pearson, 2016), consisting of two grade-level narrative texts. Students read each story aloud for one minute, and the score was the average number of words read correctly.

Procedure

There were three sessions conducted by two research associates with extensive experience as educators and researchers.

Phase 1. The first two sessions, which made up Phase 1, were whole-class administrations. Session 1 was administration of the GRADE. In Session 2, which occurred the following day, students took the MRQ, followed by the SRF-O in the school's computer lab that contained sufficient desktop computers for a class of 30-35 students.

Phase 2. The results of the SRF-O were used to identify students for the second phase of the study. The distribution of SRF-O comprehension accuracy was severely skewed. Two-thirds of the students either answered all questions correctly ($n = 27$) or made a single error ($n = 13$). The remaining one-third of students answered 58% to 92% of the questions correctly ($M = 81\%$). Within the lower third, students were distributed in three groups: 92% ($n = 7$), 76% to 88% ($n = 7$), and 58% to 75% ($n = 7$). These 21 students were chosen for participation in Phase 2 of the study. Each student chosen for Phase 2 was individually administered the ORF and the SRF-P. This session occurred one week after the completion of Phase 1.

Results

The report of results begins with Phase 1, in which all students participated, and then moves to Phase 2, where students with moderate to poor comprehension on the SRF-O assessment were given additional tasks.

Phase 1: All students

For Phase 1, we computed descriptive statistics and correlations among the variables (SRF-O comprehension and rate, GRADE, and MRQ) for all 61 students. Another Phase 1 analysis was a comparison of the Grade 4 and Grade 6 texts with respect to comprehension and rate for students at different levels of overall SRF-O comprehension.

Descriptive statistics. The sample was above-average in reading ability, with a mean GRADE Total score of 109.0 ($SD = 11.2$), about one-half standard deviation above the national

average. No students scored below 85 on GRADE Total. Performance on Listening Comprehension was average ($M = 99.7$, $SD = 12.8$).

SRF-O administration time ranged from 5 to 13 minutes, averaging 8 ½ minutes. There were 56 students with complete and valid scores for all six texts. In addition, five students with missing data on one or two texts were included in most analyses, with the comprehension and rate scores of the missing texts being imputed through multiple regression based on the four or five available texts. Most analyses used variables that were sums or averages across all of the texts, minimizing the effect of individual missing values.

SRF-O performance over time. Table 2 reports on reading rate and comprehension for each SRF-O text for the five levels of SRF-O comprehension that were described earlier as the basis for selection of Phase 2 participants (i.e., 100%, 96%, 92%, 76% to 88%, and 58% to 75%). Differences in SRF-O rate among the levels were small and not statistically significant. Table 2 reports reading rate and comprehension on each SRF-O text by comprehension level. The bounces in rate apparent in some groups reflect the alternating text-complexity levels.

The three highest comprehension groups (i.e., 100%, 96%, 92%) showed a slight increase in rate from the first to the sixth text but with no change in comprehension. The fourth comprehension group (i.e., 76% to 88%) had a greater increase in rate (about 7 WPM per text) but maintained a consistent level of comprehension. The poorest comprehenders (i.e., 58% to 75%) showed a different pattern: their reading rate increased by over 18 WPM per text ($r = .91, p < .05$), largely due to an abrupt increase in rate after the second text (from 150 WPM to 205 WPM). Compared with the other comprehension groups, this group had by far the lowest reading rates on texts 1 and 2 but the highest rates on texts 3, 4, and 6. Furthermore, this group's comprehension declined from the first text (.86) to the last text (.55; $r = -.97, p < .01$).

Because of the high rates and low comprehension on the later texts (especially text 6) for students with poor overall comprehension, we decided to include only the first four texts of SRF-O in subsequent analyses. Dropping the last two texts made the four-text version of SRF-O comparable in length to the SRF-P administered in Phase 2, and so equalized the factor (perhaps motivation or fatigue) that caused the extreme performance on later texts.

Level and correlates of SRF-O performance. After dropping the last two texts, students' overall comprehension accuracy ranged from .67 to 1.00 (M = .93). As shown in Table 3, GRADE Total correlated moderately with both comprehension (r = .50) and rate (r = .55) on SRF-O, while the GRADE Listening Comprehension score correlated .30 with SRF-O comprehension and was unrelated to SRF-O rate. The positive relationship of SRF-O comprehension with GRADE Total was triangular (Figure 1). Almost all students with relatively high GRADE Total scores had good comprehension on SRF-O, but students with lower GRADE Total scores had varying SRF-O comprehension scores, including a number with perfect or near-perfect comprehension. Thus, reading ability as measured by GRADE Total did not explain poor SRF-O comprehension.

None of the MRQ scales correlated with SRF-O comprehension, indicating that students' self-perceptions did not influence the degree to which they extracted meaning as they read. However, the MRQ Efficacy and Preference for Challenge scales each correlated .46 ($p < .001$) with SRF-O rate, indicating that students who viewed themselves as good readers tended to read more rapidly. The MRQ scales relating to students' involvement with and curiosity about texts were uncorrelated with SRF-O rate.

In examining the relationship of SRF-O comprehension to text complexity, we evaluated the performance of three SRF-O comprehension subgroups: Perfect comprehenders (1.00, n =

32), Good comprehenders (.88-.94, $n = 19$), and Poor comprehenders (.67-.80, $n = 10$). Table 4 reports SRF-O comprehension and rate on the two levels of text by comprehension group for the 57 students with data for all four texts. Comprehension did not differ significantly between text levels for the whole sample or for any group. The sample as a whole read the sixth-grade text slower than the fourth-grade text, but this difference correlated .31 ($p < .05$) with overall SRF-O comprehension accuracy, meaning that the students who read with the poorest comprehension tended to read the sixth-grade text as fast or faster than the fourth-grade text.

Phase 2: Relatively poor SRF-O comprehenders

For the Phase 2 students, we first compared the distributions of comprehension accuracy on SRF-P and SRF-O. Then we computed correlations among SRF-O and SRF-P comprehension and rate, GRADE, and ORF rate and accuracy. Next, we compared SRF-O performance with SRF-P performance for students at different levels of SRF-O comprehension. Finally, we repeated the analyses of the effects of text complexity and serial order, this time with SRF-P.

Descriptive statistics. Table 5 shows descriptive statistics and correlations among scores on GRADE, SRF-O, SRF-P, and ORF for 21 students in Phase 2. Table 6 shows performance on the SRF-O, SRF-P, and ORF measures by the Good SRF-O comprehenders (accuracy = .88) and the Poor SRF-O comprehenders (.67-.80). SRF-P administration took 3 to 10 minutes (average of 6 minutes).

On GRADE Total and Listening Comprehension, these students scored about one-half standard deviation lower than the full sample of 61 students. Their mean ORF rate was at the 52nd percentile on aimswebPlus national norms and was not notably low in either comprehension group (67th and 36th percentiles for Good and Poor SRF-O comprehenders respectively). ORF

word-reading accuracy was high (97% or better) in each comprehension group. The one student who had ORF accuracy below 90% (88% accuracy, 50 WMP) also had low SRF-O comprehension accuracy (.75).

Assessment context and CBSRR. Comprehension was higher on SRF-P, administered one-on-one with paper materials ($M = .96$, $SD = .04$), than on SRF-O, administered independently onscreen ($M = .83$, $SD = .10$; paired samples $t(20) = -5.63$, $p < .0001$). On SRF-P there were nine perfect scores, 10 scores of .94 accuracy (1 error), and two scores of .88 accuracy. Because this sample had been selected for their low comprehension on SRF-O, regression to the mean accounted for a portion of their improved comprehension on SRF-P, but their expected average accuracy due to regression (calculated with reference to all 61 students) was only .87, well below the observed value of .96.

Reading rate did not differ significantly between SRF-O and SRF-P in the Phase 2 sample or either SRF-O comprehension subgroup. Overall, the Phase 2 students' mean rate on the SRF-P Grade 6 texts was 181 WPM, which is at the 81st percentile on aimswebPlus SRF national norms.

Correlations among SRF, ORF, and GRADE. Reading rates on SRF-O and SRF-P correlated strongly ($r = .71$) but SRF-P rate had a higher correlation than SRF-O rate with GRADE Total (.72 vs. .63) and ORF rate (.83 vs. .65). These results suggest that silent reading rate is a more valid measure of reading ability when students read with comprehension.

ORF rate correlated highly (.77) with GRADE Total. Because of the strong relationships among GRADE Total, SRF-P rate, and ORF rate, stepwise regression analyses were conducted to see whether oral and silent reading rate each made a unique contribution to the prediction of reading ability. When ORF rate was included first as a predictor of GRADE Total, SRF-P rate

did not add significantly ($F(1,18)=0.83$). However, when SRF-P rate was entered first, ORF rate made a significant incremental contribution ($F(1,18)=4.47, p<.05$).

SRF-P performance between text levels and across administration duration. There was no difference in either rate or comprehension between Grade 4 and Grade 6 texts on SRF-P. Mean rates were 181 and 180 WPM for Grade 4 and Grade 6 text, respectively, and average comprehension was .95 and .97.

Across the four texts of the SRF-P administration, rate increased slightly (average of 3.9 WPM per text) as did comprehension (average increase in proportion correct of .01 per text). Students in the Poor SRF-O comprehension group, who had read with increasing speed and declining comprehension across the texts in the independent, on-screen, had stable rate and comprehension when they read with good comprehension on SRF-P.

Discussion

Relatively little is known about the interplay of rate and comprehension during silent reading. This study aimed to use the separate information about reading rate and comprehension provided by a new measure of CBSSR to explore the nature, causes, and measurement consequences of poor comprehension during independent silent reading of relatively easy texts and questions. From the perspective of reading assessment methodology, the fact that the construct of CBSRR presupposes good comprehension makes it valuable to learn about the conditions that elicit comprehension.

The present study replicated the finding of previous studies that a portion of students engages in dysfunctional silent reading behavior in an on-screen, independent context. In this study of a typical group of sixth-grade students, 16% of students had less than .80 comprehension accuracy, which is consistent with previous research (Hiebert et al., 2010;

Spichtig et al., 2016). These students increased their rate from text to text with decreasing comprehension in the SRF-O task, a phenomenon also reported by Hiebert et al. (2010).

Causes of poor comprehension. A key finding of this study is that, although the students who comprehended poorly during independent on-screen reading of easy narrative text (i.e., on the SRF-O task) were relatively weak readers, low reading ability did not explain their poor comprehension. The strongest evidence is the fact that these students comprehended well when comparable text and questions were administered on paper under the observation of an examiner (the SRF-P task). Also, a substantial portion of their classmates with the same reading ability, as measured by GRADE Total, comprehended well on SRF-O. Furthermore, with one exception, the students with SRF-O comprehension accuracy below .90 had high word recognition accuracy (an average of 97% correct) on the grade-level texts of the ORF measure, which have a Lexile value of 1010. The ORF reading rates of the poorest silent-reading comprehenders were below average but adequate, averaging at the 36th percentile.

If these students had sufficient general reading ability and, in particular, sufficient word-recognition ability to read with good basic comprehension on SRF-O, then some other factor(s) must account for their poor SRF-O performance. Of the variables included in the study, only administration condition appeared to have a significant impact.

Text complexity had little effect on comprehension. Students who generally read the SRF-O texts with reasonably good comprehension slowed their rate on the more complex texts, while maintaining high comprehension accuracy. The poor SRF-O comprehenders read the more complex texts faster and with poorer comprehension, but both effects were small and nonsignificant, especially in light of the large difference in average Lexile between the Grade 4 texts (454L) and the Grade 6 texts (732L).

General reading motivation as measured by the MRQ did not appear to account for poor SRF-O comprehension. Students who rated themselves as being good readers or as more attracted to challenging reading materials did read faster than others, but their comprehension was not better.

Several of the findings suggest that the poor SRF-O comprehenders were willing to make a tradeoff between rate and comprehension during independent on-screen reading. They read the initial SRF-O texts slowly with marginal comprehension, but they read the remaining stories faster and with worse comprehension. Also, when text was more complex, they did not slow down as other students did, and their comprehension dropped slightly.

The poor SRF-O students' higher comprehension in the one-on-one paper administration was not associated with a reduction in reading rate. They did not display the increase in rate and diminution of comprehension across texts that they had on SRF-O. This suggests that one or more of the differences between the SRF-O and SRF-P administrations--the modality (on-screen vs. paper) and the administration environment (independent vs. observed) significantly influenced these students' reading behavior.

Comprehension and the validity of rate. A second noteworthy finding, along with some students' surprisingly poor comprehension in the independent on-screen administration condition, was the strong validity of these students' silent reading rates when they read with good comprehension on SRF-P. In the Phase 2 sample, GRADE Total and ORF rate correlated .63 and .64, respectively, with silent reading rate in the independent on-screen condition but .72 and .83 with rate in the one-on-one paper condition. This, along with other findings in this study, is consistent with the interpretation that, when students read with comprehension, their rate is a function of their reading ability. This generalization may apply particularly to less able

readers; in this study, the correlations of CBSSR with reading ability were higher among the moderate to poor SRF-O comprehenders than in the entire sample.

Because reading ability and text complexity are complementary, in that it is the difference between them that affects reading performance, another manifestation of the same phenomenon is that students who read with comprehension will read more slowly when texts are more complex, as observed on SRF-O (although not on SRF-P). Amendum et al. (2017) reported a similar pattern in which variation in text complexity affects students' rate more than comprehension.

Despite the indications that reading rate is most valid as an indicator of reading ability when students are reading with comprehension, this study did not support the expectation that a CBSSR measure would be more valid than oral reading fluency, a measure that does not explicitly require comprehension. Not only did SRF-P rate (with good comprehension) not correlate higher than ORF rate with GRADE Total, but SRF-P rate did not improve on the prediction from ORF rate alone. Rather, as also found by Trainin et al. (2015), ORF added to the prediction from a CBSRR measure, suggesting that ORF taps a particularly important aspect of reading ability.

Furthermore, although CBSSR correlates strongly with reading ability, especially among less-proficient readers, our findings do not say anything about whether high CBSRR contributes to good comprehension, or whether students should receive instruction directed at raising their CBSRR. High CBSRR may be considered to be desirable in itself because being a more efficient reader is beneficial in many real-world settings. On the other hand, this study provided evidence that less-proficient readers sometimes make a speed-comprehension tradeoff, in which case encouraging speed could be detrimental to effective reading.

In summary, the substantial correlations of the CBSSR scores from SRF-O and SRF-P with reading ability, along with the explicit requirement of basic comprehension, make this type of SRF measure potentially useful for progress monitoring, especially in upper elementary and middle school where students mainly read silently. Finding a way to elicit basic comprehension from nearly all students, as SRF-P appears to do, would make the on-line administration more consistently valuable.

Limitations

As with any study but particularly one in an area such as CBSRR that has little existing research, findings should be interpreted with caution. In particular, the sample was small and did not include students who are very low in reading proficiency. We do not know the minimum level of reading ability required for students to be able to read with near-perfect comprehension in a one-on-one paper administration, as the weakest readers in this sample did. This means that even if a CBSRR measure is administered under optimal conditions for comprehension, there may be some students for whom it is not a viable progress-monitoring tool because they cannot comprehend adequately.

A key methodological limitation of the study is that the dimensions of independent vs. one-on-one administration and onscreen vs. paper format were not separated . Any of these factors may have been responsible for the difference in comprehension between SRF-O and SRF-P. Further, text segments averaged about 40 words, so findings cannot be extended to assessments such as the National Assessment of Educational Progress (National Assessment Governing Board, 2008), whose texts average approximately 750-1,000 words on the fourth-grade assessment.

The role of self-monitoring of comprehension and self-regulation of reading behavior was not explicitly investigated in this study. This is a worthy area for future research because the CBSRR assessment model in which students cannot look back places a greater demand on these variables than do other types of assessment of silent reading fluency. Although it can be inferred from the students' good SRF-P comprehension that they were capable of self-monitoring and self-regulation, we do not know whether they engaged in these behaviors when taking SRF-O.

Implications for instruction

An argument can be made that a critical aspect of literacy by the middle grades is the ability to read texts independently in digital contexts. Even when the text and questions are relatively easy, data from this assessment indicate that some students do not attend to texts digitally and independently. From this perspective, attention moves to the nature of instruction and potential interventions.

To create appropriate instruction, insight is needed into current silent reading opportunities in classrooms. Available information, albeit sparse, indicates that much of students' reading is "scaffolded" in elementary classrooms (Brenner, Hiebert, & Tompkins, 2009) and even in middle and high school contexts (Swanson et al., 2016). In scaffolded reading, others—peers, teacher, or audios—read the text aloud and students either follow along or simply listen. The limited available evidence raises the question whether the amount of time most students spend on independent silent reading is sufficient for reaching instructional goals.

In summary, rates of silent reading have gone down among American students (Spichtig et al., 2016). In the knowledge age, reading is a critical skill. Findings that confirm that some students engage in fast reading with poor comprehension of accessible text (as in the SRF-O task) provide a window into a potentially important type of dysfunctional reading behaviors.

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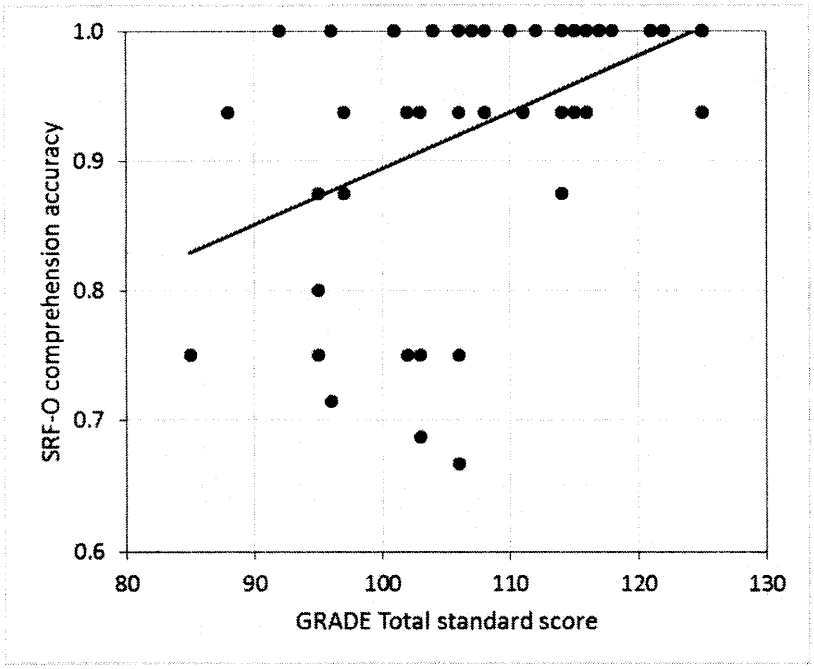

Figure 1. SRF-O (4 texts) comprehension accuracy as a function of GRADE Total.

Table 1

Features of SRF-O and SRF-P Texts Before and After Modification, by Text Level

		Original		Modified	
Text level	Feature	*M*	*SD*	*M*	*SD*
Grade 4	Lexile	522	120	454	30
	Sentence length	9.2	1.4	8.4	0.4
	Word frequency[a]	3.75	0.04	3.75	0.01
Grade 6	Lexile	740	73	732	33
	Sentence length	11.0	0.9	10.8	0.5
	Word frequency[a]	3.53	0.05	3.53	0.01

[a] Logarithm of frequencies of individual words in text samples using their rankings within the MetaMetrics database

Table 2

SRF-O Rate and Comprehension by Text and Comprehension Group

Compre-hension	*n*		Text 1	2	3	4	5	6	Slope
			Rate (words per minute)						
100%	27	Mean	183	171	184	165	205	186	2.9
		SD	48	49	55	39	56	55	
96%	13	Mean	183	178	198	175	210	198	4.1
		SD	39	57	60	45	71	58	
92%	7	Mean	202	202	188	167	232	196	1.2
		SD	64	74	64	46	59	46	
76%-88%	7	Mean	182	162	180	196	189	215	7.5
		SD	55	71	74	71	76	104	
58%-75%	7	Mean	141	150	205	203	196	243	18.4
		SD	52	58	93	64	74	93	
All	61	Mean	180	172	189	175	206	199	5.3
		SD	50	57	61	49	63	66	
			Comprehension (proportion correct)						
100%	27	Mean	1.00	1.00	1.00	1.00	1.00	1.00	.00
		SD	.00	.00	.00	.00	.00	.00	
96%	13	Mean	1.00	.96	.94	.94	.94	.96	-.01
		SD	.00	.09	.11	.11	.11	.09	
92%	7	Mean	.93	.86	.96	.96	.86	.93	.00
		SD	.12	.13	.09	.09	.13	.12	
76%-88%	7	Mean	.79	.86	.92	.79	.75	.86	.00
		SD	.17	.13	.13	.17	.25	.20	
58%-75%	7	Mean	.86	.77	.70	.61	.62	.55	-.06
		SD	.20	.18	.21	.24	.23	.41	
All	61	Mean	.95	.93	.95	.91	.90	.93	-.01
		SD	.12	.12	.12	.17	.18	.19	
Grade Level			4	6	4	6	4	6	
Lexile			440	700	440	730	460	730	

Table 3

Phase 1: Intercorrelations and Descriptive Statistics for Scores on GRADE, SRF-O, and MRQ

	GRADE		SRF-O		Motivation for Reading Questionnaire			
	Total	Listening Comp.	Rate	Compre-hension	Efficacy	Pref. for Challenge	Involve-ment	Curiosity
GRADE								
Total		.30*	.55***	.50***	.43***	.34**	.09	-.09
Listening Comp.			-.03	.30*	.00	.14	.15	-.01
SRF-O								
Rate				.12	.46***	.46***	.00	.04
Comprehension					.24	.22	.05	-.14
MRQ								
Efficacy						.56***	.12	.03
Challenge							.27*	.36**
Involvement								.01
Curiosity								
Total								
N	61	61	61	61	58	58	58	58
Mean	109.0	99.7	176	0.93	3.07	2.94	3.23	2.95
SD	11.2	12.8	49	0.10	0.75	0.63	0.51	0.53

Note. SRF-O scores are based on texts 1-4. GRADE Listening Comprehension stanine scores were transformed to standard scores (M=100, SD=15). MRQ scores are average item ratings (1 to 4).

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 4

Phase 1: SRF-O Comprehension and Rate by Text Complexity and Comprehension Group

Compre-hension Group	*n*	Comprehension					Rate (WPM)				
		Gr. 4 text		Gr. 6 text			Gr. 4 text		Gr. 6 text		
		M	*SD*	*M*	*SD*	*t*	*M*	*SD*	*M*	*SD*	*t*
Perfect	31	1.00	.00	1.00	.00	--	187	48	171	41	4.15***
Good	19	.94	.07	.91	.07	0.70	190	54	175	52	2.47*
Poor	7	.77	.09	.72	.09	0.80	173	66	189	37	-0.91
All	57	.95	.09	.94	.10	1.33	186	51	174	44	3.18**

Note. Paired-samples *t* test. Only cases with data for all four texts were included.
* $p < .05$ ** $p < .01$ *** $p < .001$

Table 5

Phase 2: Intercorrelations and Descriptive Statistics for Scores on GRADE, SRF-O, SRF-P, and ORF

	GRADE		SRF-O		SRF-P		ORF	
Score	Total	List. Comp.	Rate	Comp.	Rate	Comp.	Rate	Acc.
GRADE								
Total	---	-.03	.63**	.32	.72***	.04	.77***	.72***
Listening Comp.			-.04	-.05	.16	.10	-.21	-.27
SRF-O								
Rate				.22	.71***	-.50*	.65**	.48*
Comprehension					.35	-.02	.20	.06
SRF-P								
Rate						-.42	.83***	.53*
Comprehension							-.37	-.09
ORF								
Rate								.71***
Accuracy								---
Mean	102.0	93.0	173	.83	181	.96	151	.97
SD	11.0	13.6	58	.10	65	.04	43	.03

Note. $N = 21$. GRADE Listening Comprehension stanines were transformed to standard scores (M=100, SD=15).
* p<.05 **p<.01 ***p<.001

Table 6

Phase 2: Mean (SD) of SRF-P, SRF-O, and ORF Scores by SRF-O Comprehension Group

	SRF-O Comprehension Group		
	Good	Poor	All
N	11	10	21
SRF comprehension			
Online	.91 (.03)	.74 (.04)	.83 (.10)
Paper	.96 (.05)*	.96 (.03)***	.96 (.04)***
SRF rate (WPM)			
Online	187 (59)	158 (54)	173 (58)
Paper	208 (73)	152 (41)	181 (65)
ORF rate			
Rate (WPM)	164 (37)	136 (45)	151 (43)
Accuracy	.98 (.02)	.97 (.04)	.97 (.03)

Significant difference between online and paper: * $p<.05$, *** $p < .001$