Effects of Scaffolded Silent Reading Practice on the Reading Related Eye Movements of US Students in Grades 4 and 5.

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Background

Educators widely agree that the goal of reading instruction is to develop proficient and engaged readers. There is less consensus, however, about how to achieve this goal. This research evaluated the impact of scaffolded silent reading practice (SSRP) in comparison to "business as usual" instruction. Four measures of reading efficiency were collected; reading rate, fixations and regressions per 100 words, and fixation duration. Eye movement recordings were collected from fourth and fifth grade students (~ ages 10 and 11) while they read standardized fourth grade level passages, each followed by a brief comprehension test.

Method

Students were paired based on their initial reading proficiency scores on the *Group Reading Assessment Diagnostic Evaluation* (GRADE; Williams, 2001) and on demographic factors. Random assignment was then used to divide students into control and treatment groups. Controls received their typical reading instruction during their literacy blocks (~25 hours of instructional time), while the treatment group engaged in SSRP (~ 25 hours of instructional time) using a web-based silent reading program (Reading Plus®).

SSRP (Treatment Group)

Each lesson involved reading an informational or literary passage that the student selected from an array of choices aligned with their individual level of reading proficiency. The passages were followed by ten comprehension questions aligned with CCSS ELA Literacy Anchor standards (CCSSI, 2010) appropriate for the grade level the student was working on. Students in the treatment group who failed to complete at least 60 lessons (and their pair from the control group) were not included in this analysis.

Reading passages were presented through a moving window that traveled across lines of text and down the page at a student's individualized reading rate. Words could only be distinguished when viewed through the moving window. The width of the window was about one-third of a line length, or about 25 letters. The general features of each page, such as paragraph breaks and general word shape, could also be discerned (see Figure 1).

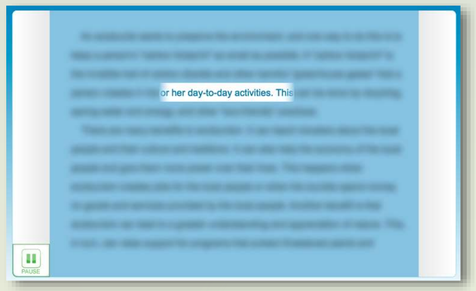

Figure 1. The Reading Plus Guided Window display.

Eye Movement Recordings

Eye movement recordings were obtained from 196 students (98 pairs) at both the start and the end of the 2015-2016 school year using a low-cost, portable eye movement recording system that uses goggles fitted with infrared emitters and sensors to measure corneal reflections at a sampling rate 60 Hz (Visagraph, Taylor, 2009). Students wore the goggles while reading standardized grade 4 passages from a normed test booklet (Figure 2). Each passage comprised 12 lines of text containing about 120 words. Data from the first and last line were discarded to minimize anomalies while starting and ending a passage. Analyses were based on data from the middle 10 lines, which contained 100 words. Each test passage was followed by a brief comprehension check involving 10 true/false questions.

Figure 2. Student reading text from a normed test booklet while eye movements were recorded using the Visagraph.

Measures

Measures included silent reading rate (words per minute; wpm), number of fixations per 100 words, number of short-range regressions (up to about 15 letters) per 100 words, and average fixation duration. Grade level norms for these measures have been established (Spichtig et al., 2016). Due to limitations of the Visagraph system, the reported fixation duration times include saccade time (approximately 20-40 ms), and the regression counts do not include long-range regressions (which typically account for < 3% of regressive saccades; Vitu & McConkie, 2000).

Results

Students in both the treatment and control groups increased their reading proficiency and efficiency during the school year. Overall gains on the GRADE reading assessment were significant ($p < .001$). Moreover, students who completed at least 60 Reading Plus lessons achieved significantly larger gains than their peers in the matched control group (Figure 3, Group x Trial Interaction, $p = .03$).

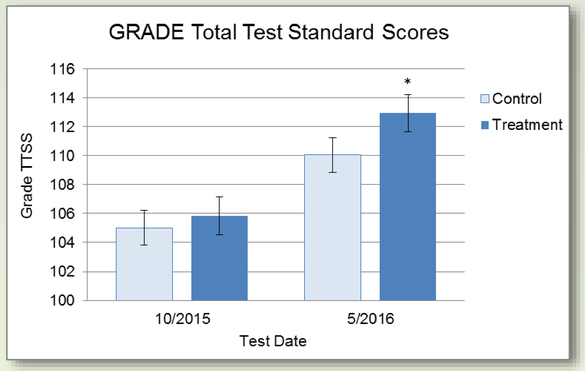

Figure 3. Fall 2015 and spring 2016 GRADE Total Test Standard Scores achieved by matched pairs of students in grades 4 and 5.

Reading Efficiency

The SSRP treatment group achieved significantly larger improvements in three reading efficiency measures (reading rate, fixations, and regressions) in comparison to their peers in the control group. There was no significant effect on fixation duration (Table 1).

Table 1. Fall and spring measures of reading efficiency in grade 4 and 5 students receiving business as usual instruction (control group) or scaffolded silent reading practice (60+ sessions; treatment group).

	Control (n = 98)			Treatment (n = 98)			Group x Trial Interaction		
	Fall	Spring	Change	Fall	Spring	Change	F	*p*	η^2
Reading Rate (wpm)	170	182	12	170	198	28	5.32	0.022	0.03
Fixations per 100 words	134	132	-3	134	120	-14	8.08	0.005	0.04
Regressions per 100 words	22.7	22.4	-0.3	22.7	17.6	-5.1	8.14	0.005	0.04
Fixation Duration (ms)	286	275	-11	286	278	-8	0.16	n.s.	-

Notes: Data shown are from analyses of covariance using baseline values as the covariate. In no case did control and treatment baseline values differ by more than three percent. Fixations and regressions are per 100 words. Only short range regressions (up to about 15 characters) are included. Fixation durations are shown in milliseconds, and include saccade time. Abbreviation: *p*, two-tailed probability; η^2, partial eta squared.

Conclusions

These results suggest that SSRP may be more effective than typical instructional practices in helping students become more proficient and efficient readers. Students who engaged in SSRP achieved larger reading efficiency gains as measured by greater increases in reading rate and larger decreases in fixations and regressions over the course of a school year. In turn, research has shown a positive association between efficient reading and reading comprehension (e.g., Rasinski, Padak, McKeon, et al., 2005). This association may help to account for the larger reading proficiency gains achieved on the GRADE by students who engaged in SSRP. Whether these encouraging results were a consequence of scaffolded silent reading practice, the additional layer of the structure and pacing provided by the moving window, and/or other factors, is a matter for future research. Nevertheless, the results are encouraging in that they suggest that SSRP can, at the very least, be an efficacious addition to educators' instructional toolboxes.

References

- Common Core State Standards Initiative (2010). National Governors Association Center for Best Practices and the Council of Chief State School Officers. Washington, DC: Authors. www.corestandards.org.
- Rasinski, T. V., Padak, N. D., McKeon, C. A., Wilfong, L. G., Friedauer, J. A., & Heim, P. (2005). Is reading fluency a key for successful high school reading? *Journal of Adolescent & Adult Literacy, 49*(1), 22-27.
- Spichtig, A.N., Hiebert, E.H., Vorstius, C., Pascoe, J.P., Pearson, P.D., & Radach, R. (2016). The decline of comprehension-based silent reading efficiency in the United States: A comparison of current data with performance in 1960. *Reading Research Quarterly, 51*(2), 239–259.
- Spichtig, A., Vorstius, C., Greene, A. & Radach, R. (2009, August). *Visagraph III and EyeLink2K: A comparison study*. Poster session presented at the European Conference on Eye Movements. Southampton, UK
- Taylor, S. E. (2009). *Visagraph III: Implementation guide*. Huntington Station, NY: Taylor Associates Communications.
- Vitu, F., & McConkie, G. W. (2000). Regressive saccades and word perception in adult reading. In A. Kennedy, R. Radach, D. Heller & J. Pynte (Eds.), *Reading as a perceptual process* (pp. 301-26). Amsterdam, The Netherlands: Elsevier.
- Williams, K. T. (2001). *The Group Reading Assessment and Diagnostic Evaluation (GRADE). Technical Manual*. San Antonio, TX: Pearson Education, Inc.