Comparing Passage Lengths and Human vs Speech Recognition Scoring of Oral Reading Fluency

Joseph F. T. Nese
Julie Alonzo
Akihito Kamata

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Joseph F. T. Nese, Julie Alonzo, Akihito Kamata
University of Oregon, Behavioral Research and Teaching
Southern Methodist University

Purpose

The purpose of this study is to explore a computerized oral reading fluency (ORF) system that uses speech recognition software (CORE). The purposes were as follows.

(1) Compare the mean *WCPM* scores across:
   a) three passage lengths (short≈25 words, medium≈50 words, long≈85 words), and
   b) three scoring methods (real-time, audio recording, and ASR)

(2) Compare the error rates across the passage lengths.

(3) Compare the timing duration of read passages between: human assessors in real time as in traditional ORF, and computer estimates.

(4) Analyze the agreement of word-level scores (correct or incorrect) across the three scoring methods.

Method

Sample. Students' response times < 2.5 secs were removed. Students' *WCPM* scores > 1.9 times different between the three scoring methods were removed. As a result, five Grade 2 and seven Grade 3 students were removed from the analysis sample. Sample sizes were 127 for Grade 2, 158 for Grade 3, and 162 for Grade 4.

Passages. Administered via computer: 18 passages (3 long, 5 medium, 10 short).

(1) *Short:* ≈25 words, read in entirety.
(2) *Medium:* ≈50 words, read in entirety.
(3) *Long:* ≈85 words, read in entirety.

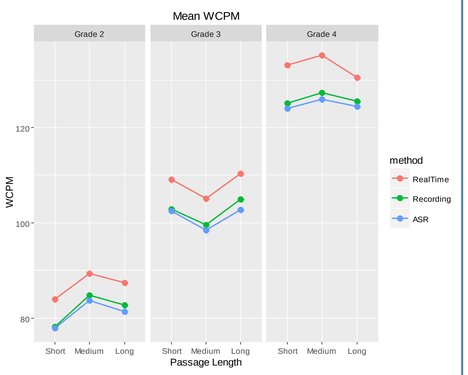
Scoring. Word accuracy and words correct per minute (WCPM) were scored by:

(1) *Real-time:* trained human assessors as in traditional ORF.
(2) *Audio Recording:* trained human assessors via audio recordings.
(3) *Automated Speech Recognition* (ASR).

Analyses. Mixed model approach with two within-subject variables to test the mean *WCPM* and error rate differences between passage length, scoring method, and their interaction. The **length** factor included three categories short, medium, and long. The **scoring** method factor included three categories: Real-Time, Recorded Audio, and ASR.
Cohen's kappa[2] was used to analyze the agreement between word-level scores across the scoring methods.

Results

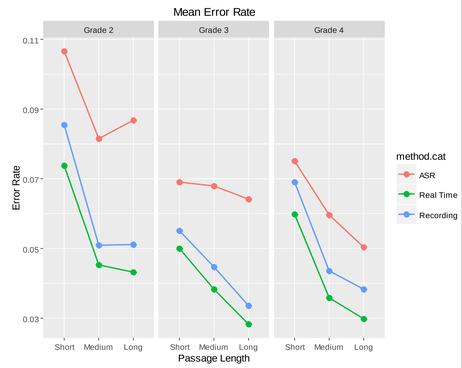
(1) Comparisons of *WCPM* Scores

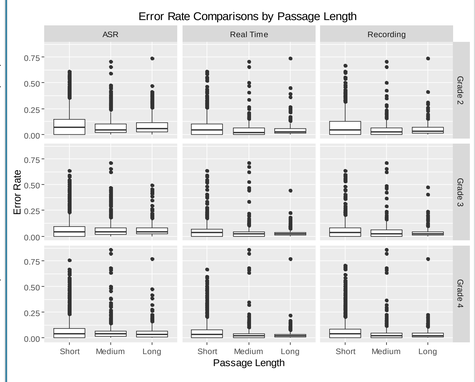


Statistical Significance of Main Effects (Length and Scoring Method), Interaction, and Pairwise Comparisons

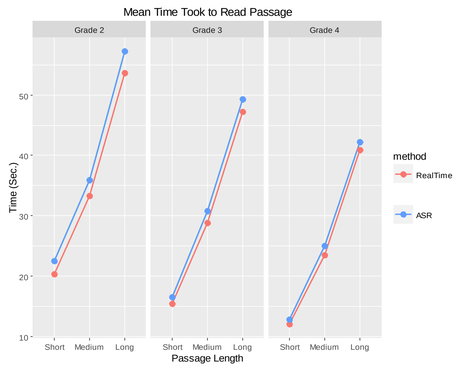
	Grade 2	Grade 3	Grade 4
Passage Length	*	*	*
Short vs. Medium	*	*	
Short vs. Long		*	
Medium vs. Long	*	*	*
Scoring Method	*	*	*
Recording vs. Real-Time	*	*	*
Recording vs. ASR		*	
ASR vs. Real-Time	*	*	*
Length x Method			

(2) Comparisons of Error Rates

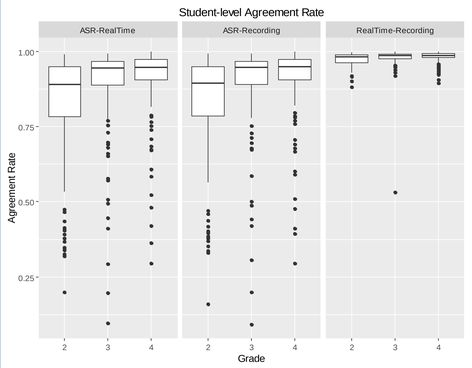


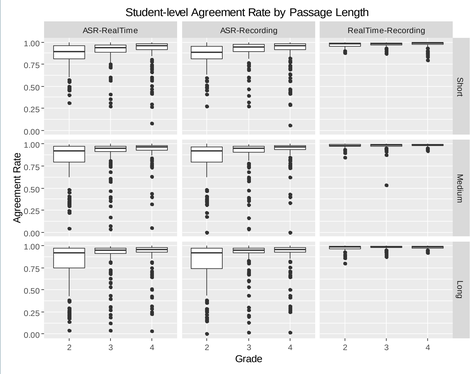


(3) Comparisons of Timed Duration



(4) Word-Level Agreement





Conclusions

▸ Across grades, significant main effects for passage LENGTH and scoring METHOD, no significant interaction effect, and mixed results for pairwise comparisons.
▸ Recorded Audio and Real-Time scores were different across grades, but Recorded Audio and ASR scores were quite similar for all passage lengths and grades.
▸ Real-Time scores were higher than both the ASR and Recording.

Limitations
- Same time duration used for ASR and Recordings *WCPM* scores.
- Greater time durations for ASR and Recordings scores (see RQ 3) will deflate *WCPM* scores.
- Lost scores due to technology benefits comparison of ASR to Recordings (no lost Real-Time data).

Error Rate: the proportion of words that were scored as incorrect for a given passage.

▸ The mean error rates ranged from 3% to 10%, when they were disaggregated by grade, scoring methods, and passage length.
▸ Error rates were highest for ASR.
▸ Error rates were lowest for Real-Time scoring.
▸ Error rates were higher for shorter passages.
▸ Error rates were higher for lower grade levels.

▸ The timed passage duration was consistently greater (approximately 1-2 secs) the for ASR scoring methods than the Real-Time scoring method.
▸ Because the ASR and Recording scoring methods used the same time duration to compute *WCPM*, this would lead to decreased *WCPM* scores compared to the Real-Time scoring method.

▸ Although it is not possible to determine the "true" passage timed duration, we hypothesize that the ASR computer-generated time would be the most accurate. The ASR time is the duration from the utterance of the first passage word, to the termination of the last word read, in centi-seconds.

▸ The Recorded Audio to considered the reference, because scoring could take place in a quiet setting with no distractions, and the capability to rewind the recording to ensure the most accurate word scores. The primary interest was to compare the Recorded Audio scores to both the Real-Time and ASR scores.
▸ The agreement rate was quite varied between students for ASR vs. Real-Time, and for ASR vs. Recording.
▸ The two human scores (Recording and Real-Time) had the highest kappa agreement.
▸ Average ASR vs. Real-Time Cohen's kappa: Grade 2 = .82, Grade 3 = .90, and Grade 4 = .91.
▸ The ASR may need additional training, especially for lower grade levels.
▸ Next step is to investigate instances of low agreement.
▲ Is kappa ≈ .90 "good enough" if ASR can save considerable resources (time, money, instruction)?

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Further Information

jnese@uoregon.edu | http://brtprojects.org

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[2] Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement,* 20, 37–46.