

# Model-Based Approach to Oral Reading Fluency Assessment

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## Outline

- Background: Traditional ORF Assessment
- Background: Improved ORF Assessment
- Model-based Approach to ORF
- R Package Development
- Next Steps

# 1

# Background 1

## Traditional ORF Assessment



## Traditional ORF Assessment 1

- A student is given one minute to read as many words as possible in a grade-level text.
- Typically a length of about 250 words.



## Traditional ORF Assessment 2

- A trained assessor follows along and indicates each word the student reads incorrectly.
- After one minute, the number of the words read correctly per minute (WCPM) is reported as a score of ORF.



## Limitations of Traditional ORF Assessment 1

- One-to-one test administration and manual scoring can be a burden for assessors.
- The validity and reliability of manual scoring can be questionable.



## Limitations of Traditional ORF Assessment 2

- Scores are based on observed accuracy and reading time.
- Score comparability is hard to ensure.  
Typically relies on:
- Expert's judgement of passage difficulties.
- Observed-score equating.



## Limitations of Traditional ORF Assessment 3

- Measurement error is available only at the sample level.
- No conditional measurement error is available.

# 2

## Background 2

Improved ORF Assessment



## Improved ORF Assessment System 1

- Improved ORF assessment system was developed in a previously funded IES project (R305A140203).



## Improved ORF Assessment System 2

- Passage lengths are substantially shorter than traditional ORF assessment.
- Multiple passages would be administered to students.
- Sufficient time would be given for students to complete their reading.



## Improved ORF Assessment System 3

- The assessment delivery is computer-based.
- The system audio-records student's reading.
- As a result, accuracy and time data at the word level can be collected.

# 3

## Model-Based Approach to ORF

Psychometric Model for ORF  
Assessment



## Why Model-based ORF Measure? 1

- Passages and ORF scores can be equated via model parameters.
- Common-passage non-equivalent group design to collect data.



## Why Model-based ORF Measure? 2

- Standard error can be estimated for each model-based ORF scores.
- Conditional SEM (CSEM).



## ORF Psychometric Model 1

- It is a joint latent factor model, comprised of accuracy model and speed model.
- It is a modification of van der Linden (2007).



## ORF Psychometric Model 2

- Accuracy model is a binomial factor model.
- The number of correct responses is modeled as a binomial distribution.
- The probability of correct response for each word is modeled as a function of passage discrimination and difficulty parameters, as well as latent accuracy factor score.



## ORF Psychometric Model 3

- Speed model is a log-normal factor model.
- The speed of response is modeled as a function of passage discrimination and difficulty parameters, as well as latent speed factor score.



## ORF Psychometric Model 4

- Expected count of words correctly read and expected reading time are estimated for a particular reader for a selected set of passages in the calibrated passage pool.
- Then, ORF score (model-based WCPM) and its SE are estimated.



## Practical Use of the ORF Model 1

- Calibration data are collected for all passages in a passage pool.
- Passage parameters are estimated for all passages.



## Practical Use of the ORF Model 2

- A student takes a selected set of passages from the passage pool.
- Then, accuracy and speed latent factor scores are estimated.
- Finally, a model-based WCPM score and its SE are estimated for any selected set of passages in the passage pool.

# 4

## R Package Development

R Package Under Development: orfr



## Why R Package?

- Our aim is to make the model-based approach to ORF assessment scoring widely available to educational researchers who use ORF scores in their research.



## Features of the R Package 1

- The package estimates/calibrates passage parameters.
- The package estimates students' model-based WCPM scores and SE's.



## Features of the R Package 2

### **Estimating Passage Parameters:**

Monte-Carlo EM

Bayesian MCMC

### **Estimating model- based WCPM scores:**

MLE

MAP

EAP

Bayesian MCMC

### **Estimating Standard Errors:**

Analytic method

Monte-Carlo  
bootstrap method



## What Have Been Done with R Package

### Passage Calibrations:

150 passages for 2<sup>nd</sup> to 4<sup>th</sup> grade levels have been calibrated into an equated passage pool.

### Estimating model-based WCPM scores:

Model-based WCPM and SE for approx. 2,000 students have been estimated on up to 4 measurement occasions.

# 5

## Next Steps



## Under Current Project: R305D200038

### R Package

We are finalizing the first beta-version release.

Web-based tutorial will be developed.

We are looking for test users of the package.

### Psychometric Model

Will extend to sentence-level data, by incorporating dependency between sentences within passage.

This will make the model-based approach be more widely applicable.



## Under Another Current Project: R305A200018

A tablet app will be developed.

### **Features will include:**

Automatic speech-recognition engine.

Prosody as part of fluency measure.

Automated model-based scoring for speed, accuracy, and prosody.

# Thank you!

Please contact me at [akamata@smu.edu](mailto:akamata@smu.edu)