A Comparison of Modeling Growth in Reading via CBM & CAT

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INTRODUCTION

- Preventive focused frameworks, such as multi-tiered systems of support, identify students as at-risk for academic difficulties and deliver supplemental evidence-based interventions.
- While delivering interventions, educators must periodically collect student performance data to determine their response to interventions.
- Curriculum-based measurement (CBM; Deno, 1985) is arguably the most common progress monitoring tool to assess student progress.
- However, computer-adaptive tests (CATs) are another option.
- There are several differences between CBM and CATs that may have implications for how they quantify student growth.

Purpose

- To determine whether Star CBM Reading (CBM-R) and Star Reading (SR), a CAT, capture growth in unique reading skills and if the growth in overall reading skill by CBM-R and SR were distinct.

Research Questions

- (1) To what degree does growth, on average, measured concurrently via CBM-R and SR differ across a school year?
- (2) To what degree do the assessments differ in their capacity to capture meaningful variability in growth between students?
- (3) To what degree do the assessments differ in their sensitivity to quantifying student growth, across a school year?

METHOD

Participants

- Extant dataset managed by Renaissance Learning
- Total of 3,192 students; Grade 1 (n = 298), Grade 2 (n = 1,149), Grade 3 (n = 1,062), Grade 4 (n = 462), Grade 5 (n = 221)

Measures

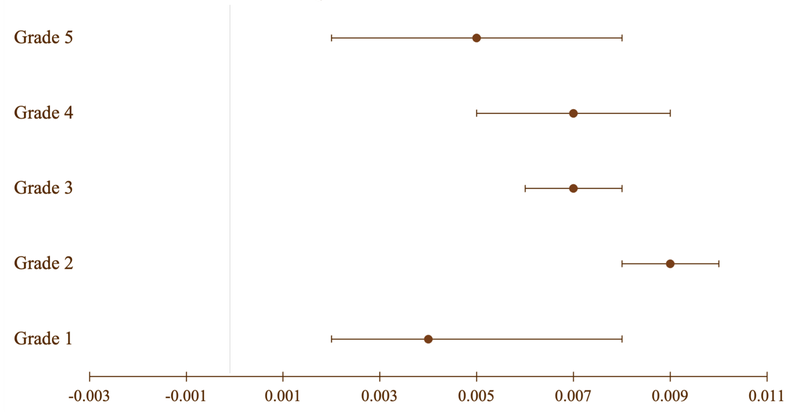
- **Star CBM Reading (CBM-R)**: a CBM designed to measure a student's growth in reading across a school year, developed by Renaissance Learning (2021).
  - Star CBM Reading contains eight measures that cover a variety of academic reading skills; however, Passage Oral Reading is the focus of this study.
- **Star Reading (SR)**: a CAT designed to assess the reading achievement of students, developed by Renaissance Learning (2022).

Analysis

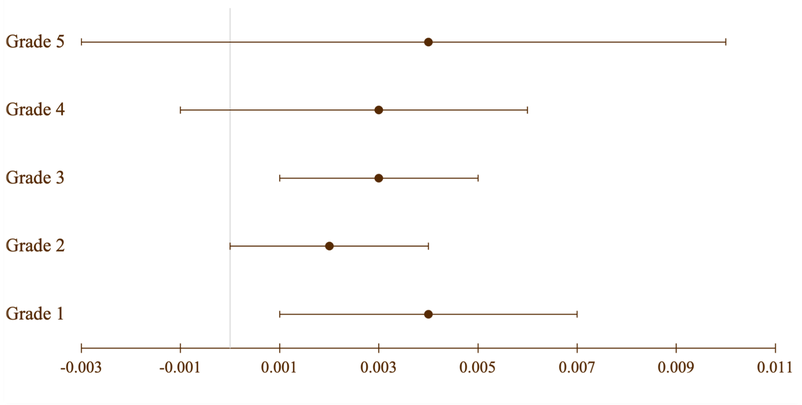
- A series of multivariate multilevel models (MMLMs) were estimated to outcomes for each grade level using the brms package (Bückner, 2017) in R (Core Team, 2022).
- Prior to model fitting, words read correct per minute (WRCM) from CBM-R and Unified Scaled Scores from SR were standardized to Z-scores within each grade level
- The posterior distribution of the differences between the following were constructed and evaluated:
  - (1) Fixed effects estimates for growth from each measure
  - (2) Random effects for slope terms from each measure
  - (3) Magnitude of residual variance between each measure

RESULTS

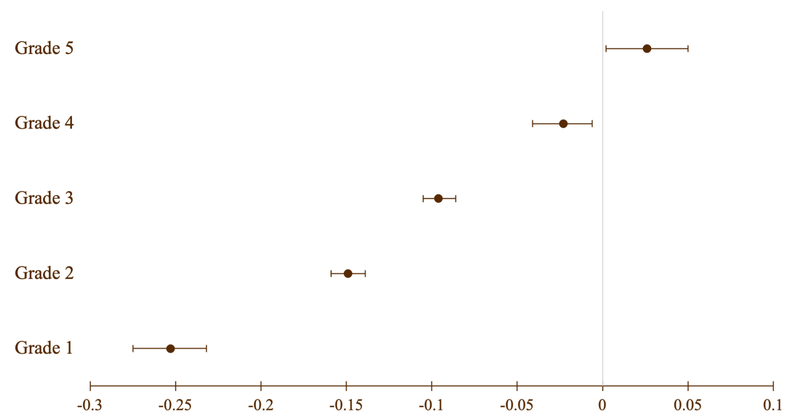
Research Question #1: Fixed Effects Growth



Research Question #2: Random Effects Growth



Research Question #3: Residual



Plots represent a summary of contrasts between standardized outcomes from CBM-R and Star Reading. Mean values of the posterior distribution of differences with 95% credible intervals are reported.

Univariate Hierarchical Growth Models

CBM	Grade One	Grade Two	Grade Three	Grade Four	Grade Five
Fixed	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)
Intercept	15.41 (1.46)	41.12 (0.95)	71.70 (1.07)	82.58 (1.48)	96.17 (2.17)
Slope	1.19 (0.04)	1.10 (0.02)	0.84 (0.02)	0.72 (0.03)	0.58 (0.05)
Random	*SD*	*SD*	*SD*	*SD*	*SD*
Intercept	22.68	30.40	33.07	28.31	28.73
Slope	0.59	0.49	0.41	0.36	0.29
Residual	9.90	11.34	13.09	17.31	16.63
Correlation	*r*	*r*	*r*	*r*	*r*
Intercept, Slope	.28	.01	-.05	.04	-.20

SR	Grade One	Grade Two	Grade Three	Grade Four	Grade Five
Fixed	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)
Intercept	719.13 (5.32)	820.58 (2.58)	895.01 (2.45)	931.82 (3.33)	970.90 (4.98)
Slope	3.38 (0.16)	2.03 (0.06)	1.34 (0.05)	0.96 (0.07)	0.99 (0.09)
Random	*SD*	*SD*	*SD*	*SD*	*SD*
Intercept	70.32	78.11	73.08	63.86	66.94
Slope	1.38	1.11	0.70	0.60	0.33
Residual	57.07	42.59	37.17	35.98	35.84
Correlation	*r*	*r*	*r*	*r*	*r*
Intercept, Slope	-.09	-.30	-.34	-.29	-.61

Initial levels of performance….

- On CBM-R corresponded to the 23, 13, 15, 25, and 24 percentiles.
- On SR corresponded to the 21, 20, 20, 16, and 16 percentiles.

Average weekly rate of improvement …

- On CBM-R, in WRCM, ranged from 1.19 in Grade 1 to 0.58 in Grade 5.
- On SR, in scaled score points, ranged from 3.38 in Grade 1 to 0.96 in Grade 5.
- Inverse relationship between average rate of growth and student grade level.

DISCUSSION

RQ #1

- Weekly growth rates from CBM-R tended to be larger than estimates from SR.
- The largest observed posterior distribution difference was 0.009 (Grade 2) Grade 2.
- The smallest difference was 0.004 in Grade 1.
- All the 95% credible intervals did not overlap with 0.

RQ #2

- Magnitude of random effects were highly similar between assessments.
- CBM-R may yield slightly larger values.
- 95% credible intervals did not overlap with 0 in Grades 1-3 but did overlap with 0 in Grades 4 and 5.
- The largest observed posterior distribution difference was 0.004 (Grade 1).

RQ #3

- Largest differences between measures seen when comparing residual values.
- Grades 1-4: SR > CBM-R and Grade 5: CBM-R >SR
- The largest observed posterior distribution difference was Grade 1 (-0.253).
- The most similar was observed in Grade 4 (-0.023).
- Only in Grade 5, residual from CBM-R was greater than SR.

Questions? Please email erf220@lehigh.edu