An Exploration of Growth Models for Within-Year Grade 5 Oral Reading Fluency

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Abstract

Oral reading fluency (ORF) is the academic construct most often assessed using curriculum-based measurement (CBM) as part of a response-to-intervention (RTI) model, but little empirical work has attempted to examine intra-individual change in CBM ORF. In general, CBM ORF growth studies incorporate only three benchmark testing occasions (fall, winter, spring), which limits the types of growth models that can be explored and the understanding of within-year developmental ORF growth.

We examined eight within-year ORF testing occasions and explored latent growth models for 202 students in grade 5. We explored variations in growth modeling to understand more about ORF growth and to understand the methods used to model growth.

Research Objectives

1)Analyzed the effects on the **reliability of the slope** estimate by comparing:

a) a regular growth model using "HLM"
b) a regular growth model using a latent growth modeling
c) a latent growth model using two parallel processes (using alternate time points across processes)

2)Used **latent class growth analysis** (LCGA) to identify and describe theoretically meaningful groups of students based on ORF initial status and growth.

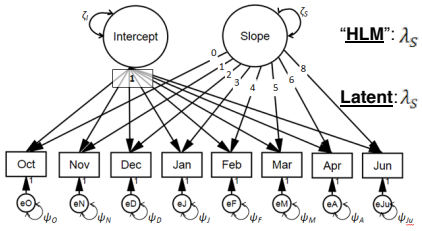
Descriptive Statistics for Entire Sample

	Mean	*SD*	*n* (missing)
Oct	158.14	44.12	192 (10)
Nov	165.71	45.45	194 (8)
Dec	171.76	43.39	191 (11)
Jan	169.46	46.29	201 (1)
Feb	175.62	45.80	197 (5)
Mar	165.22	45.73	195 (7)
Apr	186.15	50.48	198 (4)
Jun	181.99	45.07	196 (6)

	n	% of total	*Total n* (missing)
Female	96	48	199 (3)
SpEd	16	8	199 (3)
LEP Status	9	5	199 (3)
Race			198 (4)
Am Ind/AK Native	33	16	
Asian	8	4	
Black	4	2	
Hawaiin/Pac Isl	1	0.5	
White	140	69	
Multiple	12	6	
TOTAL	**202**		

Note. LEP = 67% AmInd/AK Native, 33% White, 67% female.
SpEd = 12% AmInd/Ak Native, 88% White, 31% female.

Reliability



"HLM": $\lambda_S = \dfrac{\zeta_S}{\zeta_S + \psi/n_t}$; $\psi_O = \psi_N = \psi_D = \psi_J = \psi_F = \psi_M = \psi_A = \psi_{Ju}$

Latent: $\lambda_S = \dfrac{\zeta_S}{\zeta_S + \dfrac{(\sum_O^{Ju}\psi)/n_t}{n_t}}$; $\psi_O \neq \psi_N \neq \psi_D \neq \psi_J \neq \psi_F \neq \psi_M \neq \psi_A \neq \psi_{Ju}$

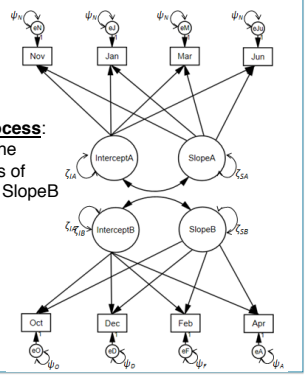
Fit Information & Reliability for the Three Growth Models

Growth Model	AIC	CFI	RMSEA	SRMR	**Reliability**
"HLM"	13803.29	.92	.18	.07	**.07**
Latent	13781.58	.93	.18	.06	**.08**
Parallel Process	14329.76	.74	.38	.55	**.04**

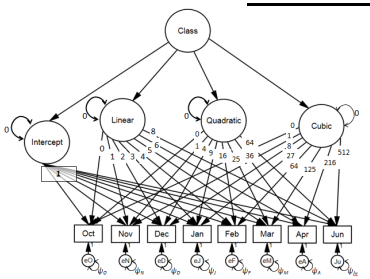
Fixed Effect Estimates for the Three Growth Models

	Intercept		Slope		
Growth Model	*M*	*SE*	*M*	*SE*	Reliability
"HLM"	161.11	3.07	2.83	0.18	-
Latent	161.92	3.08	2.65	0.19	-
Parallel Process A	163.45	3.23	2.31	0.26	.09
Parallel Process B	159.90	2.98	4.32	0.28	.07

Parallel Process: Correlated the factor scores of SlopeA with SlopeB

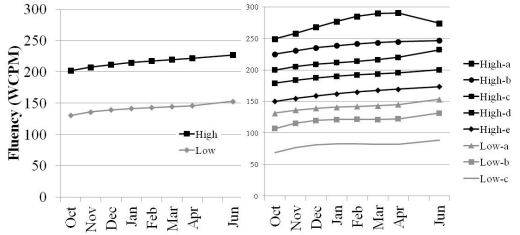


Latent Class Growth Analyses



Fit Information for LCGA Models

Model	AIC	BIC	ABIC	Entropy	BLR *p*-value
2-Class	15185.15	15241.39	15187.53	.964	.0000
8-Class	13904.70	14060.19	13911.28	.924	.0000



Results & Class Descriptives for 2-Class Model

	High		Low	
	M	*SE*	*M*	*SE*
Intercept	202.03	4.37	130.33	3.02
Linear	5.99	2.11	6.88	1.31
Quadratic	-0.70	0.64	-1.35	0.40
Cubic	0.04	0.05	0.11	0.03
Female, *n* (%)	48 (59)		48 (40)	
LEP, *n* (%)	0 (0)		9 (7)	
SpEd, *n* (%)	1 (1)		15 (12)	
Total *n* (%)	**81 (40)**		**121 (60)**	

Results & Class Descriptives for 8-Class Model

	High-a		High-b		High-c		High-d		High-e		Low-a		Low-b		Low-c	
	M	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*
Intercept	249.34	5.55	225.12	11.31	199.85	8.11	179.09	8.88	150.12	9.79	131.67	3.90	107.11	8.89	68.86	5.64
Linear	7.73	3.96	6.12	4.47	6.41	5.59	5.63	2.32	5.20	8.84	5.86	2.36	10.51	3.96	10.40	2.45
Quadratic	1.17	1.38	-0.59	1.19	-1.16	1.54	-0.82	0.75	-0.44	2.71	-1.25	0.62	-2.53	1.20	-2.50	0.81
Ccubic	-0.22	0.11	0.02	0.10	0.11	0.12	0.06	0.06	0.02	0.23	0.11	0.05	0.20	0.10	0.19	0.07
Female, *n* (%)	16 (60)		3 (38)		11 (58)		18 (46)		4 (67)		20 (41)		5 (25)		20 (56)	
LEP, *n* (%)	0 (0)		0 (0)		0 (0)		0 (0)		0 (0)		3 (6)		5 (25)		1 (3)	
SpEd, *n* (%)	0 (0)		6 (75)		0 (0)		1 (3)		0 (0)		3 (6)		5 (25)		1 (3)	
Total *n* (%)	**25 (12)**		**8 (4)**		**19 (9)**		**39 (19)**		**6 (3)**		**49 (24)**		**20 (10)**		**36 (18)**	

Conclusion

Reliability

- Latent growth model fit the data the best and had a slightly higher reliability estimate
  - Perhaps a benefit of the residual variances freed across the time points
- Parallel process model had the lowest reliability estimate
  - Model had poorer fit information and criteria
  - Perhaps because of model constraints (e.g., no correlation between InterceptA-B and SlopeA-B)
- Very low reliability estimates across all methods
  - Assumption of linear growth was not adequate
  - Research shows that within-year fluency growth is non-linear (Christ et al., 2010; Nese et al., in press, no date)

➢**Future research to explore methods to estimate the reliability of non-linear growth**

Latent Class Growth Analyses

- Moving from a 2-Class to an 8-Class model classified students only on intercept, not on slope
  - Did not encounter intersecting slopes among classes
- High-intercept class(es) exhibited linear or no growth
- Low-intercept class(es) exhibited cubic growth
  - Low class(es) included all LEP, most SpEd students

➢**Future research to look at developmental trends in growth and classes across grades and explore differences in High- and Low-intercept classes (e.g., linear vs. cubic growth)**

➢**Future research to consider how Tier 1, Tier 2, and Tier 3 instruction affect growth**

References

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For further information

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