The Relationship Between Starting-Point and Rate of Changes in Reading and Mathematics

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INTRODUCTION

- There has been a constant debate over the ways in which elementary students' academic performance develop over time.
- Issues related to the starting point and rate of changes in reading and mathematics performance have been interests of researchers in the field of literacy.
- Previous findings are not univocal in terms of Matthew Effect and compensatory trajectory.
- The current study investigated if a cumulative advantage exists in reading and mathematics performance among the 3rd and 4th graders.

- **Research Questions**

1.What is the shape of trend of elementary students' reading and Mathematics performance over time?

2.What is the relationship between the starting point (intercept) and the change rate (slope) in elementary students' reading and Mathematics performance?

3.What is the effect of elementary students' reading and Mathematics performance the relationship between the intercept and slope?

Latent Growth Curve Analysis (LGCA) can help answer these questions.

LGCM has two latent variables, intercept (initial status) and slope (growth rate):

$$Y_{ij} = \pi_{0j} + t_i\pi_{1j} + \varepsilon_{ij}$$

$$\begin{bmatrix} \textit{Total } 1(\text{3rd winter}) \\ \textit{Total } 2(\text{3rd spring}) \\ \textit{Total } 3(\text{4th fall}) \\ \textit{Total } 4(\text{4th winter}) \\ \textit{Total } 5(\text{4th spring}) \end{bmatrix} = \begin{bmatrix} 1 & t_1 \\ 1 & t_2 \\ 1 & t_3 \\ 1 & t_4 \\ 1 & t_5 \end{bmatrix} \begin{bmatrix} \pi_{0j} \\ \pi_{1j} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1j} \\ \varepsilon_{2j} \\ \varepsilon_{3j} \\ \varepsilon_{4j} \\ \varepsilon_{5j} \end{bmatrix}$$

These components are normally distributed with mean of μ and variance/ covariance of σ as

$$\begin{bmatrix} \pi_{0j} \\ \pi_{1j} \end{bmatrix} \sim N\left(\begin{bmatrix} \mu_{0j} \\ \mu_{1j} \end{bmatrix}, \begin{bmatrix} \sigma_{\pi_{0j}} & \sigma_{\pi_{0j}\pi_{1j}} \\ \sigma_{\pi_{0j}\pi_{1j}} & \sigma_{\pi_{1j}} \end{bmatrix} \right)$$

Covariance matrix of π can be decomposed into two components as

$$\begin{bmatrix} \pi_{0j} \\ \pi_{1j} \end{bmatrix} = \begin{bmatrix} \gamma_0 \\ \gamma_1 \end{bmatrix} \xi + \begin{bmatrix} \zeta_0 \\ \zeta_1 \end{bmatrix}$$

where γ is a factor loading of a predictor (ξ), and ζ represents disturbances in the equation.

METHOD

- Participants
  - A longitudinal sample of 28465 students in the middle Tennessee area was assessed.
  - Data was collected from the winter semester of grade 3 through the spring semester of grade 4 in the 2016-2018 school year for a total of five semesters.
  - The current study carefully randomly selected 489 students' data that with no missing parts.

METHOD (CONT'D)

	N	%
Caucasian	107	21.9
African American	196	196
Asian	19	3.9
Hispanic	164	33.5
Other	3	0.6
Male	251	51.3
Female	238	48.7
ELL	156	31.9
Non-ELL	333	68.1

- **Measurement**
  - ➢ Mathematics： MAP™ (Measures of Academic Progress) computer-based Mathematics Test.
  - ➢ Reading: MAP™ computer-based Reading Test.
- **Procedure**
  - ➢ Descriptive Statistics
  - ➢ Person's correlation coefficient
  - ➢ Graphs
  - ➢ Latent Growth Curve Analysis

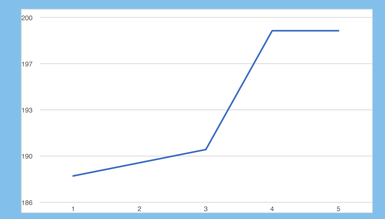
RESULTS

- Participants
  - ➢ Descriptive Analysis

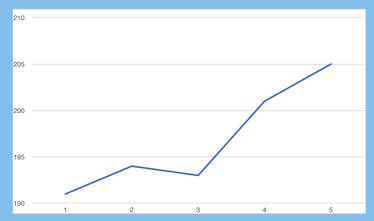
	semester	M(SD)
Reading *(N=489)*	3rd winter	187.87(16.80)
	3rd spring	188.91(17.01)
	4th fall	189.79(16.49)
	4th winter	199.00(15.34)
	4th spring	198.85(16.82)
Mathematics *(N=489)*	3rd winter	191.00(13.49)
	3rd spring	194.34(13.91)
	4th fall	193.12(14.04)
	4th winter	201.19(13.89)
	4th spring	204.53(16.20)

RESULTS (CONT'D)

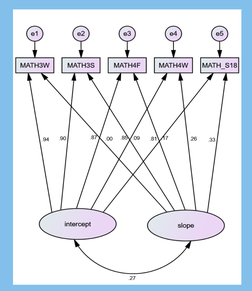
3-4 reading score



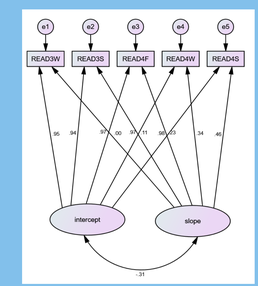
3-4 Math score



- Linear trend for reading score (F(1,488)=739.87, P<0.001).
- Linear trend for mathematics score (F(1,488)=1505.44, P<0.001).



LGCA model for math



LGCA model for reading

CONCLUSIONS

- Students' performance on reading and math are highly correlated.
- Matthew effect was evident on math performance over time.
- Compensatory trajectory was found on reading scores.

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