Variability in Reading Achievement Growth for Students with and without Disabilities: A Multilevel, Longitudinal Analysis

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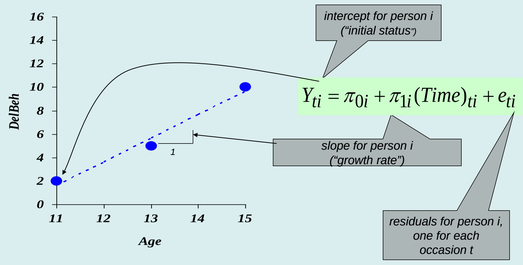
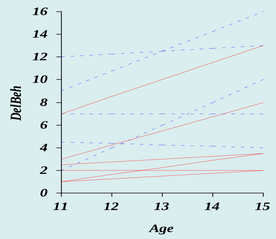
Modeling change over time: An overview

Postulate statistical models at each of two levels in a natural hierarchy

At level-1: *Model the* ***individual change trajectory****, which describes how each person's status depends on time*



At level-2: *Model* ***inter-individual differences in change****, how features of the individual change trajectories (e.g., intercepts and slopes) vary across people*



Level-2 model for level-1 intercepts

$$\pi_{0i} = \beta_{00} + \beta_{01}(X_i) + r_{0i}$$

Level-2 model for level-1 slopes

$$\pi_{1i} = \beta_{10} + \beta_{11}(X_i) + r_{1i}$$

Example from Singer & Willett (2003)

Modeling Framework:

1) Across a sample of individuals, what is the mean developmental trajectory?
2) Is there intra- and inter-individual variation in developmental trajectories?

Example Applications:

1) Modeling language acquisition over time
2) Tracking age-related changes in risk-taking and criminality
3) Identifying treatment/intervention effects on growth trajectories

Abstract

Despite the broad-based interest in estimating and explaining differences in individual growth rates, students with disabilities are often excluded from such investigations, particularly when they involve accountability testing and reporting, The current study addresses the need for studies of achievement growth that are more inclusive and representative of students with disabilities by examining growth in state reading achievement for a longitudinally matched student cohort during middle school (Grades 6-8; *N* = 58,960). Using two and three-level longitudinal growth models, we estimated the average growth trajectory and deviations from that growth trajectory by disability category (e.g., traumatic brain injury, autistic, hearing-impaired, learning disability). Results demonstrate relatively large differences in levels of achievement among disability categories as well as in comparison to the general education and academically gifted population, but rates of growth that were more similar across groups. Overall, results reveal heterogeneity within and between disability categories, suggesting that different conclusions regarding school performance may be drawn based on whether and which students with disabilities are included in accountability reporting.

Two-Level Growth Model

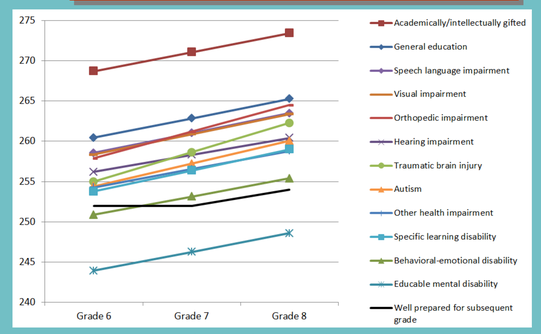


Figure 2. Reading growth as a function of exceptionality classification and grade

Level-1

$$Y_{ti} = \pi_{0i} + \pi_{1i}(Grade) + e_{ti}$$

Level-2

$$\pi_{0i} = \beta_{00} + \beta_{01}\,(\text{Exceptionality Classification}) + r_{0i}$$
$$\pi_{1i} = \beta_{10} + \beta_{11}\,(\text{Exceptionality Classification}) + r_{1i}$$

Note. Exceptionality classification was represented by multiple dummy-coded vectors

Table 1. Two-Level Growth Model Results

Fixed Effect	Coefficient	Standard error	t-ratio	p-value
For INTERCEPT1, π_0				
INTERCEPT2, β_{00}	260.448875	0.032798	7940.975	<0.001
Academically/Intellectually Gifted, β_{01}	8.257132	0.080706	102.312	<0.001
Behavioral-emotional disability, β_{02}	-9.588377	0.595240	-16.108	<0.001
Hearing impairment, β_{03}	-4.243166	0.978106	-4.338	<0.001
Educable mental disability, β_{04}	-16.526496	0.317852	-51.994	<0.001
Visual impairment, β_{05}	-2.082208	2.004641	-1.039	0.299
Other health impairment, β_{06}	-6.182748	0.352517	-17.539	<0.001
Orthopedic impairment, β_{07}	-2.558631	1.372192	-1.865	0.062
Traumatic brain injury, β_{08}	-5.448262	2.074936	-2.626	0.009
Speech-language impairment, β_{09}	-1.878414	0.211982	-8.861	<0.001
Specific learning disability, β_{010}	-6.692693	0.157135	-42.592	<0.001
Autism, β_{011}	-6.038385	0.968195	-6.237	<0.001
For TIME slope, π_1				
INTERCEPT2, β_{10}	2.398561	0.011411	210.201	<0.001
Academically/Intellectually Gifted, β_{11}	-0.043653	0.035653	-1.224	0.221
Behavioral-emotional disability, β_{12}	-0.140461	0.220583	-0.637	0.524
Hearing impairment, β_{13}	-0.300659	0.279937	-1.074	0.283
Educable mental disability, β_{14}	-0.064289	0.144570	-0.445	0.657
Visual impairment, β_{15}	0.101439	0.759559	0.134	0.894
Other health impairment, β_{16}	-0.141136	0.113570	-1.243	0.214
Orthopedic impairment, β_{17}	0.906317	0.339855	2.667	0.008
Traumatic brain injury, β_{18}	1.224600	0.716457	1.709	0.087
Speech-language impairment, β_{19}	0.061801	0.067113	0.921	0.357
Specific learning disability, β_{110}	0.218469	0.053460	4.087	<0.001
Autism, β_{111}	0.415666	0.331996	1.252	0.211

Three-Level Growth Model

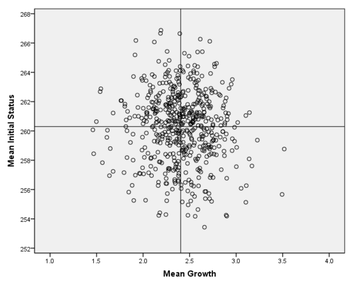


Figure 3. School mean initial status as a function of mean growth

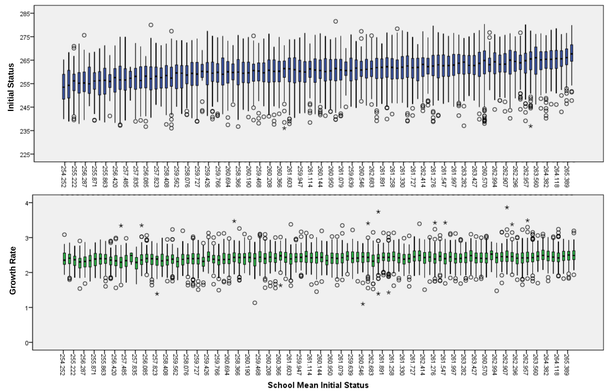


Figure 4. Within- and between-school variability in initial status and growth rates for a random sample of 100 schools

Methods

- Data source: Accountability data from a state in the southeastern U.S.
- Analytic sample: A longitudinally matched middle school student cohort (Grades 6-8; *N* = 58,960). Students had at least one test result in middle school and did not switch schools within state during middle school.
- Dependent variable: Vertically scaled state reading test (possible scores range from 216 to 290). Proficiency cut-scores for Grades 6, 7, and 8 were 252, 252, and 254 respectively.
- Analysis: Two- and three-level growth models were used to estimate growth trajectories and examine relationships between exceptionality classification and reading outcomes at the student and school level.

Results

- Intraclass correlations for 3-level growth
  - Unconditional growth model
    - Initial status: 85% within school, 15% between schools
    - Growth: 63% within school, 37% between schools
  - Conditional growth (accounting for exceptionality codes)
    - Initial status: 65% within school, 35% between schools
    - Growth: 35% within school, 65% between schools
    - Significant variance between schools in initial status for students with Academically/Intellectually Gifted, Specific Learning Disability or Speech Language exceptionality codes
    - Significant variance between schools in growth for students with Specific Learning Disability exceptionality code

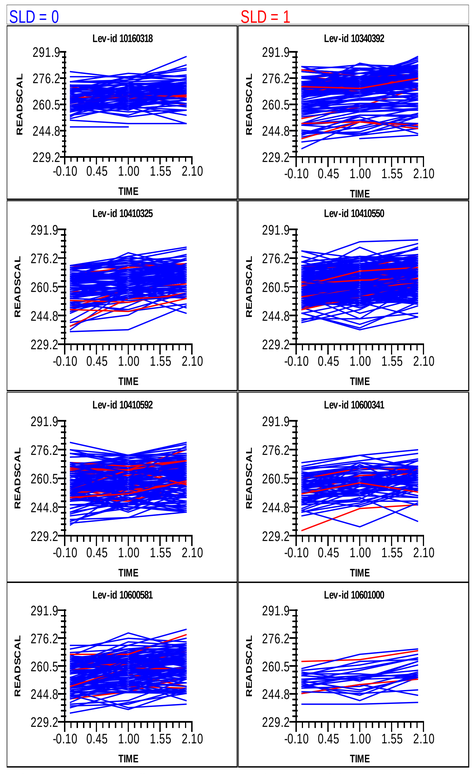


Figure 1. State reading test scores as function of time and categorization as having a specific learning disability or not.

Key Findings

- Despite initial status differences, students tended to gain reading skills at a similar rate with each passing grade regardless of exceptionality classification with the exception of students with specific learning disabilities and orthopedic impairments, who gained at a somewhat faster rate (see Figure 2)
- Reading performance level and growth varied more within than between schools before exceptionality was taken into account
- When exceptionality was taken into account, the proportion of variance between schools was much greater for growth than within schools
- Taken together, results reveal heterogeneity within and between disability categories and between schools

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