A Constellation of Findings From NCAASE

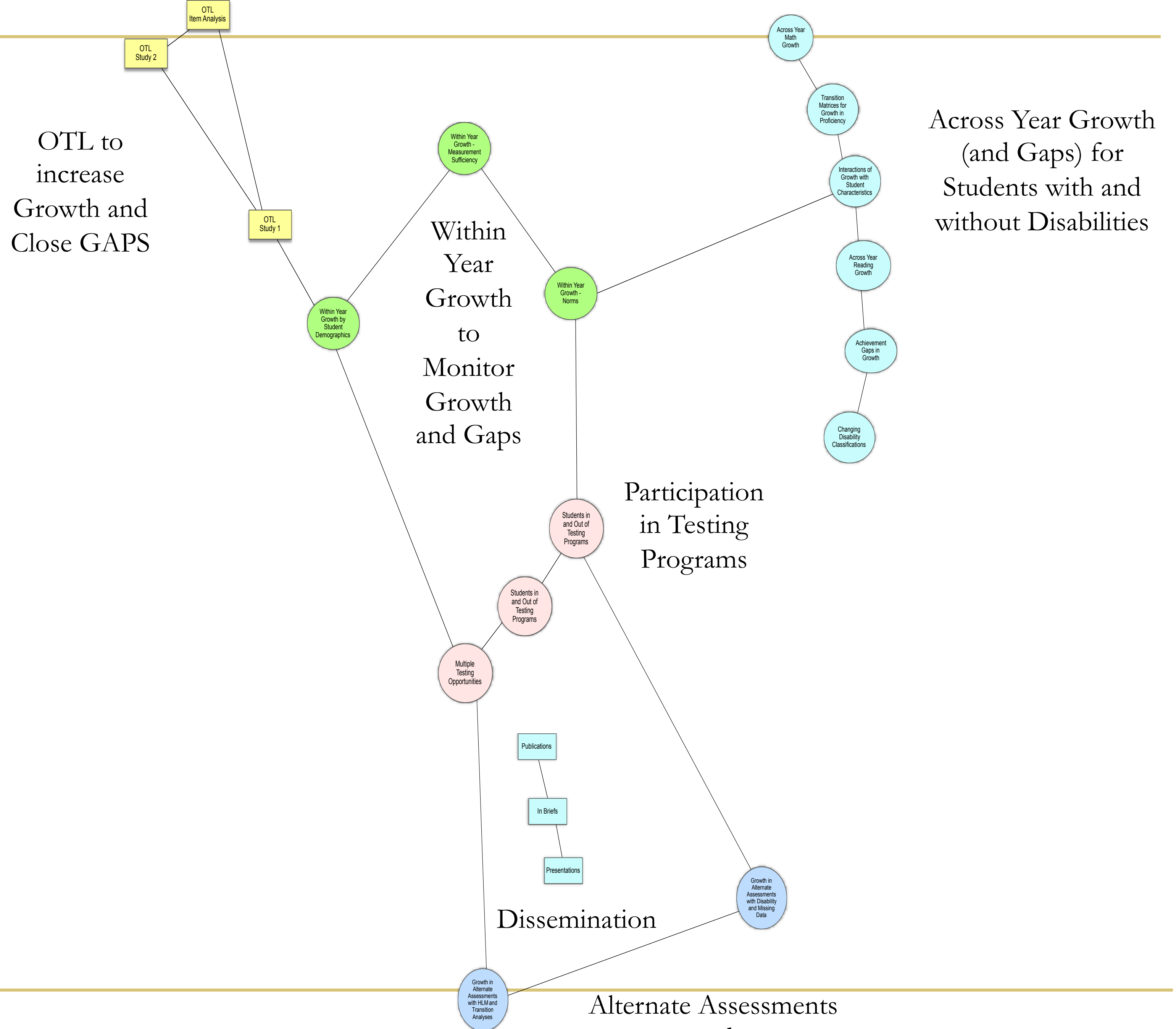
Drs. Stevens and Schulte on Across Year Growth and Gaps

Drs. Elliott, Tindal, and Nese on Within Year Growth

Dr. Stevens on Comparison of Growth Models

Six Questions turned in Numerous Studies

- 1. What is the **natural developmental progress in achievement** for students with disabilities?
- 2. What **models best characterize achievement growth for students with disabilities** who are participating in general achievement tests, as well as those taking alternate assessments?
- 3. How do various **growth models represent school effects** for students with and without disabilities, and how do results compare to those derived from status models now in use?
- 4. What are the **reliability and validity of the estimates of school effectiveness** for students with disabilities produced by alternative growth models and how are these estimates influenced by contextual differences among schools and students?
- 5. How do **results from different types of interim assessments of students' achievement** meaningfully contribute to a model of academic growth for students with disabilities?
- 6. How can **information about opportunity to learn and achievement growth** be used to enhance academic outcomes for students with disabilities?


OTL Item Analysis
OTL Study 2
OTL Study 1
OTL to increase Growth and Close GAPS
Within Year Growth - Measurement Sufficiency
Within Year Growth by Student Demographics
Within Year Growth - Norms
Within Year Growth to Monitor Growth and Gaps
Across Year Math Growth
Transition Matrices for Growth in Proficiency
Interactions of Growth with Student Characteristics
Across Year Reading Growth
Achievement Gaps in Growth
Changing Disability Classifications
Across Year Growth (and Gaps) for Students with and without Disabilities
Students in and Out of Testing Programs
Students in and Out of Testing Programs
Multiple Testing Opportunities
Participation in Testing Programs
Publications
In Briefs
Presentations
Dissemination
Growth in Alternate Assessments with Disability and Missing Data
Growth in Alternate Assessments with HLM and Transition Analyses
Alternate Assessments and Growth for SWSCD

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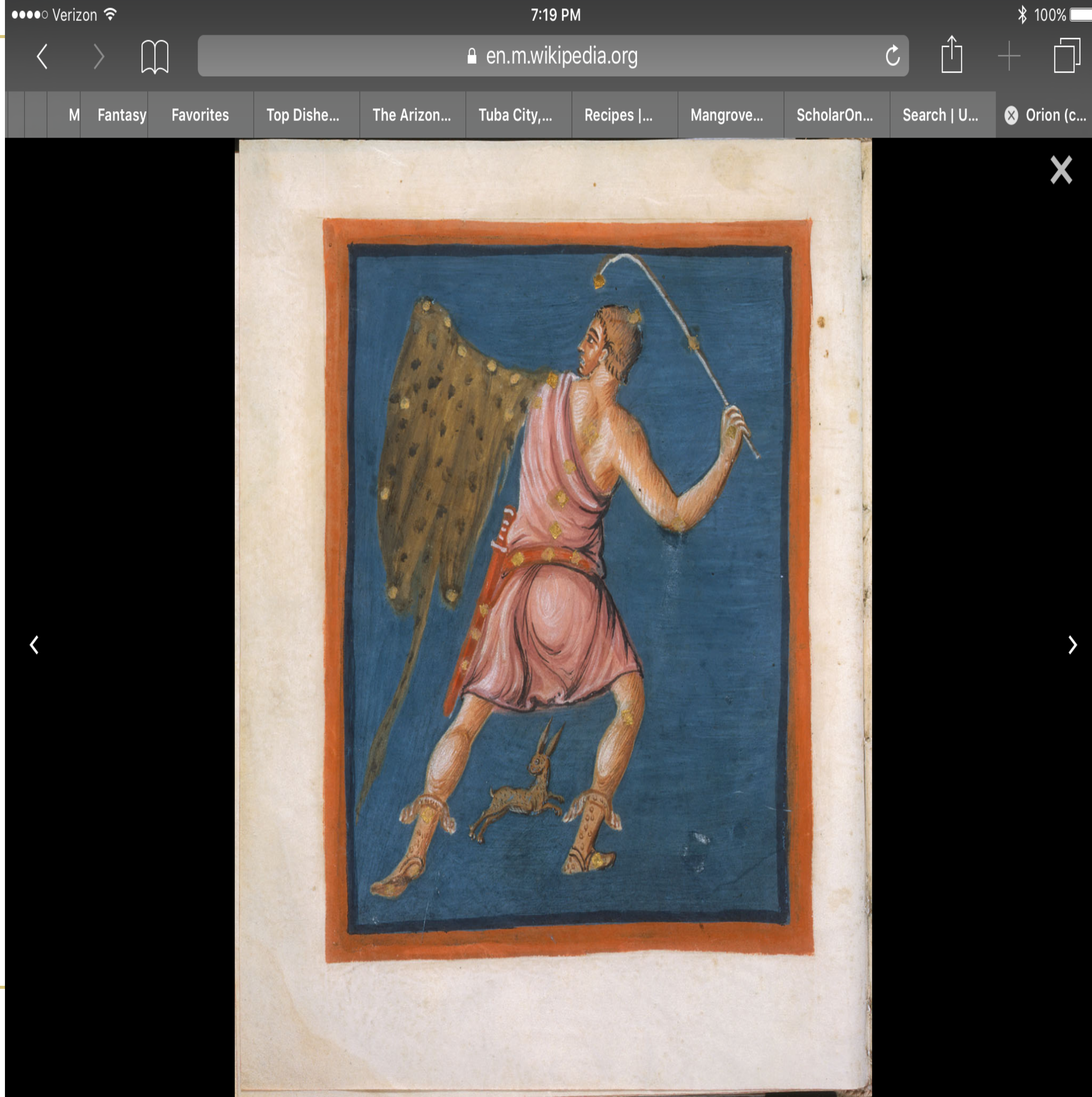
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Achievement Growth for Students With and Without Disabilities

Ann Schulte
Arizona State University

Investigating Achievement Growth for SWD

- Widespread agreement that achievement growth is an important outcome to be considered in educational accountability models
- Little information on achievement growth for SWD or how it compares to students without disabilities (SWOD) on which to base alternative models

Investigating Achievement Growth for SWD

- NCLB treats SWD as a unitary subgroup, but specific disabilities are likely to have different achievement trajectories—how different are the exceptionality groups in terms of intercept, growth, and gaps?
- What are some implications for charting growth of the changing nature of the special education population?

Schulte, A. C., Stevens, J. J., Elliott, S. N., Tindal, G., & Nese, J. F. T. (in press). Achievement gaps for students with disabilities: Stable, Widening, or Narrowing on a State-wide Reading Comprehension Test? *Journal of Educational Psychology*.

Stevens, J. J., Schulte, A. C., Elliott, S. N., Nese, J. F. T., & Tindal, G. (2015). Mathematics achievement growth of students with and without disabilities on a statewide achievement test. *Journal of School Psychology, 53*, 45-62.

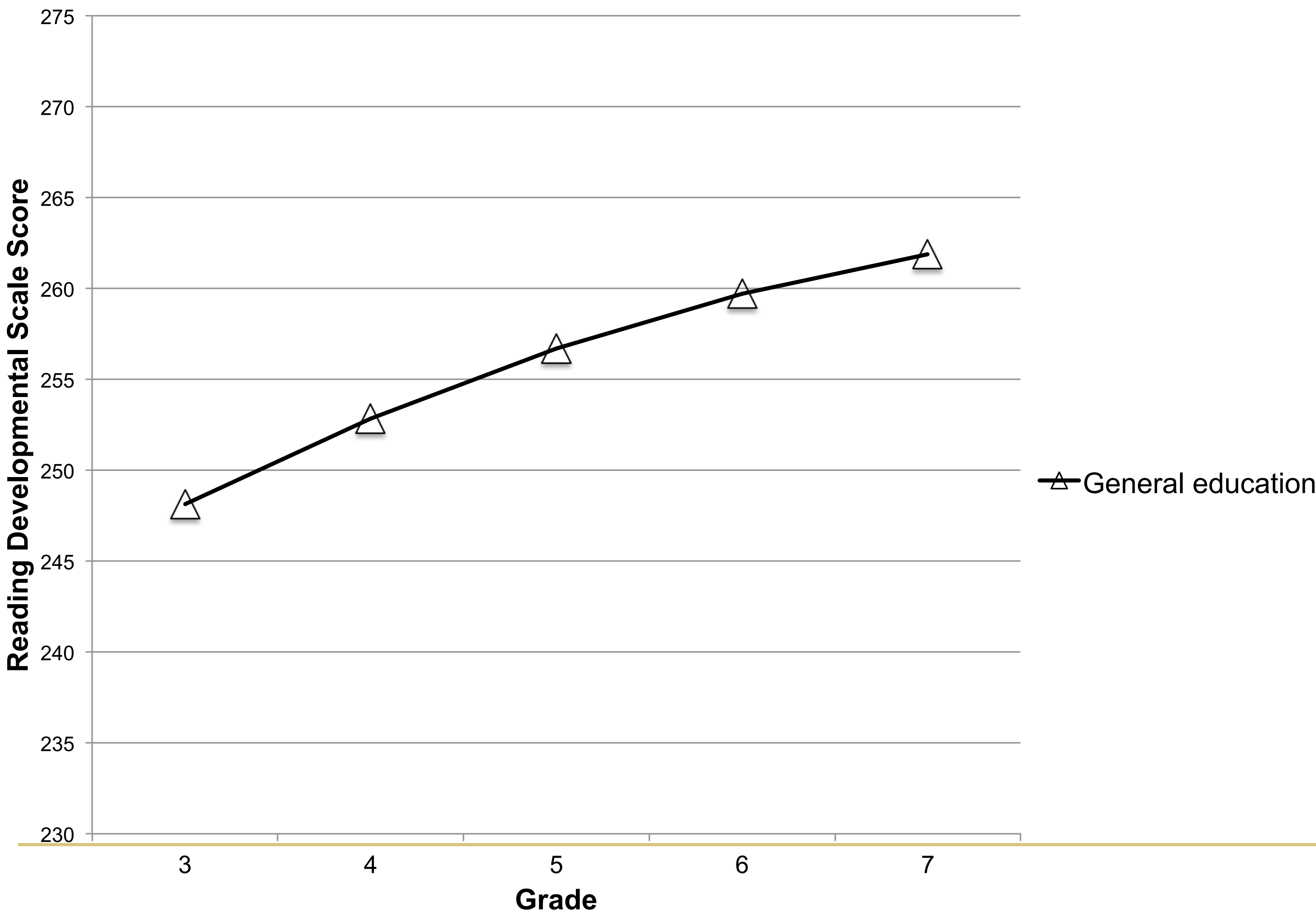
Cornerstone Growth Studies

- Followed two entire cohorts (n >95,000 each) in one state across grades 3-7, single editions of state reading and mathematics tests
- Exceptionality based on classification at Grade 3 (students who entered system after Grade 3 not included in sample)
- Two level HLMs (time and students), controlling for demographic characteristics at Level 2
- Intercept at Grade 3, both linear and quadratic functions included

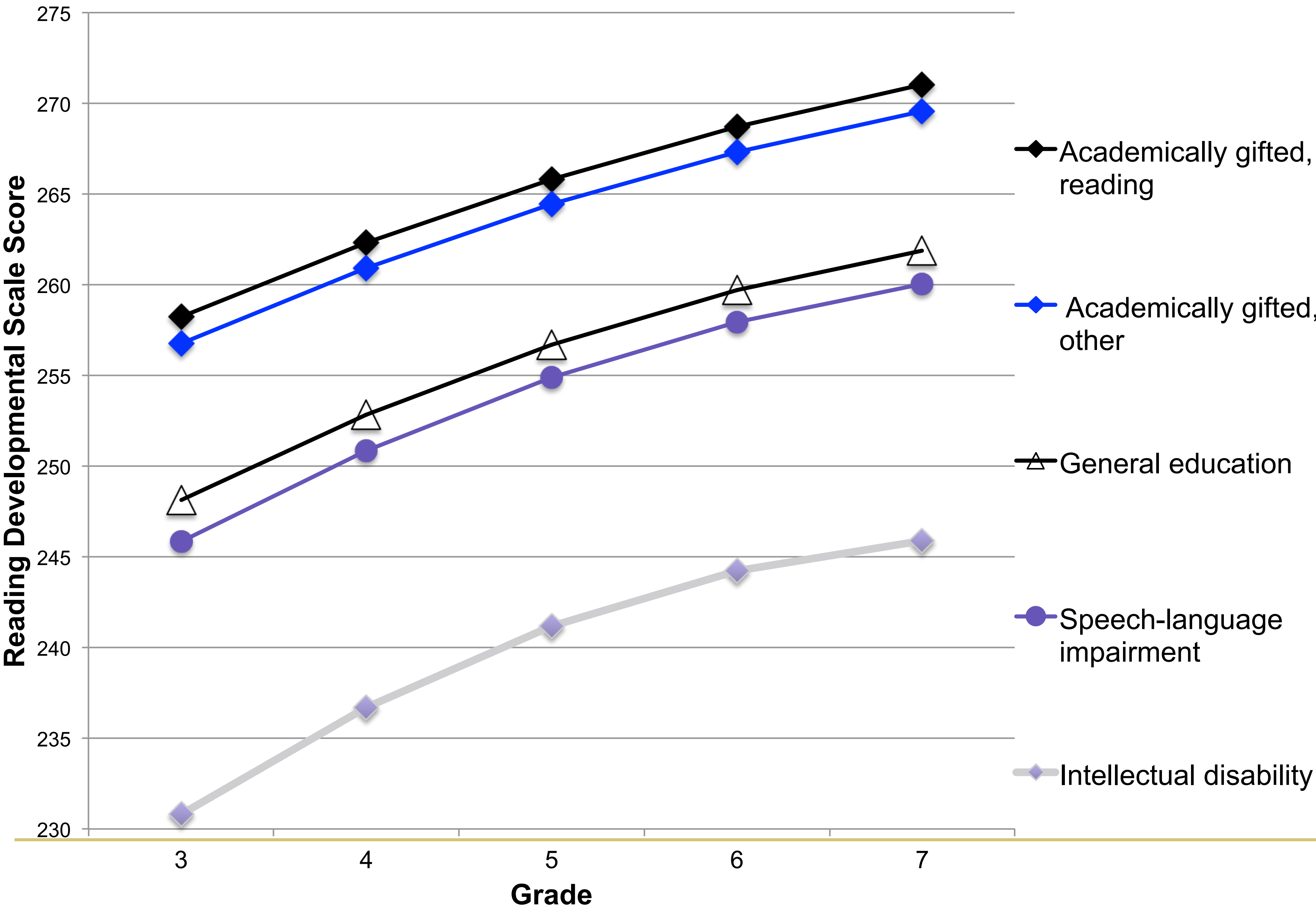
North Carolina End of Grade (EOG) Tests

- EOG-R (2nd ed.) Reading passages followed by multiple-choice items testing comprehension of passage content
- EOG-M (2nd ed.) Mathematics stressed application and problem solving
- Administered annually, grades 3-8
- Developmental scale across grades

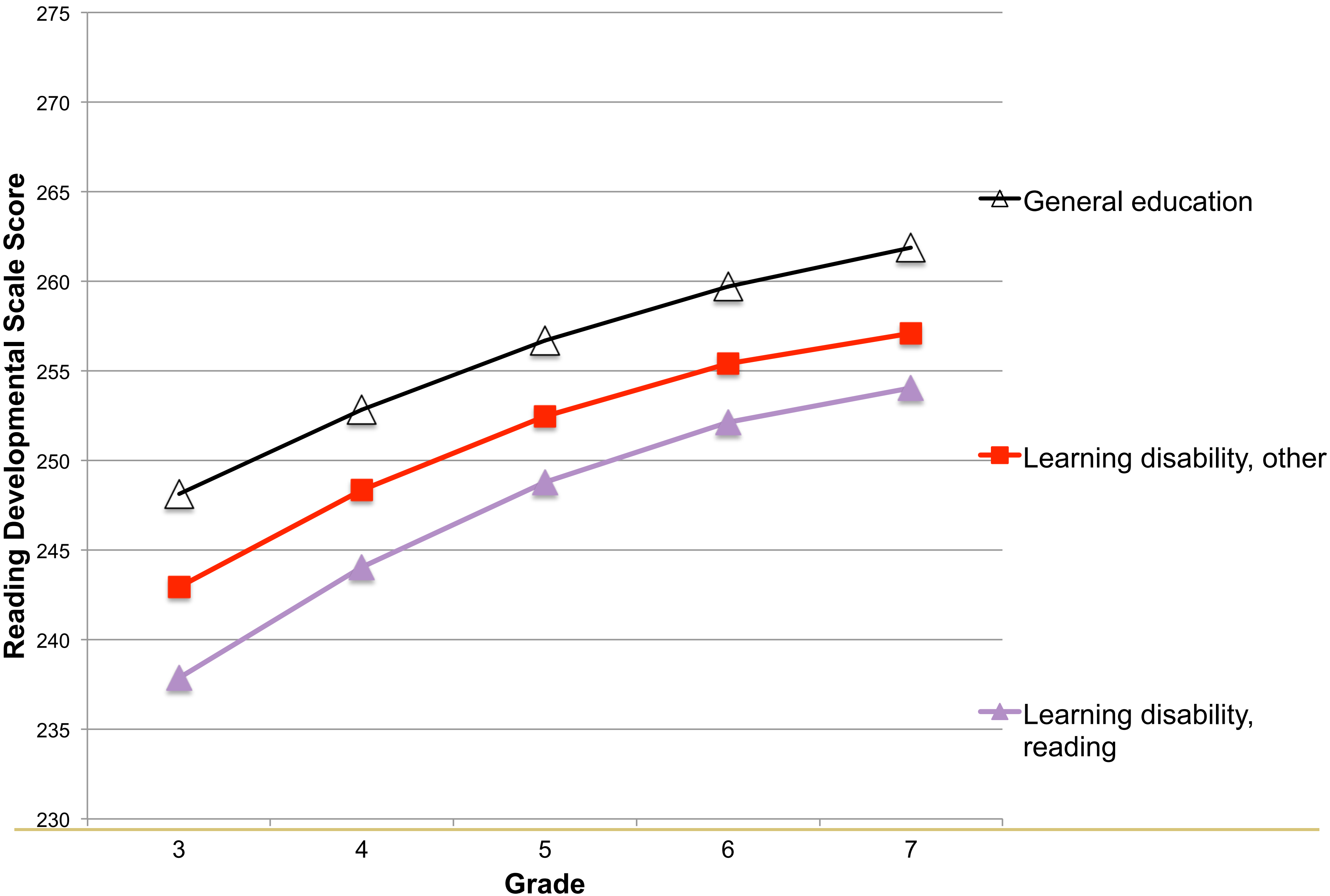
Reading Comprehension Growth by Exceptionality



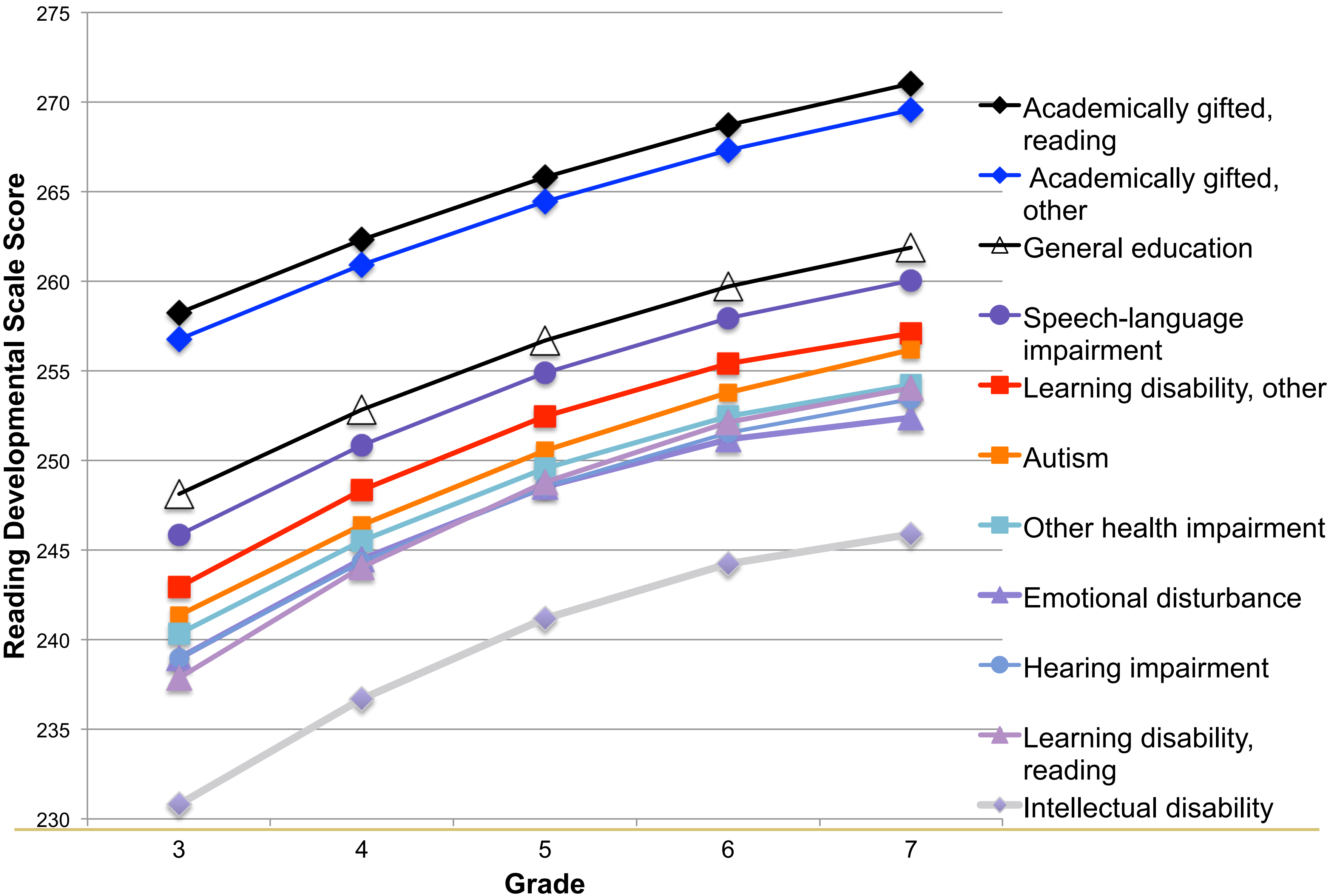
Reading Comprehension Growth by Exceptionality



Learning Disability in Reading vs. LD in Other Area



Reading Comprehension Growth by Exceptionality



Reading Comprehension Two-level HLM (Time and Students)

Predictor		Intercept	Linear	Quadratic
Grand Mean		250.82 (.04)	5.03 (.03)	-.42 (.01)
Sex		1.02(.05)	-0.17 (.03)	.07 (.01)
Free lunch		-3.61 (.06)	0.14 (.03)	-.05 (.01)
Limited English		-5.57(.16)	0.70 (.10)	-.05 (.02)
Asian		.31† (.17)	0.18† (.10)	.05 (.02)
American Indian		-2.74 (.21)	-0.62 (.13)	.12 (.03)
Black		-4.34 (.06)	0.25 (.04)	-.05 (.01)
Hispanic		-1.54 (.13)	0.40 (.08)	-.05 (.02)
Multiracial		-1.05 (.16)	0.19† (.10)	-.03† (.02)

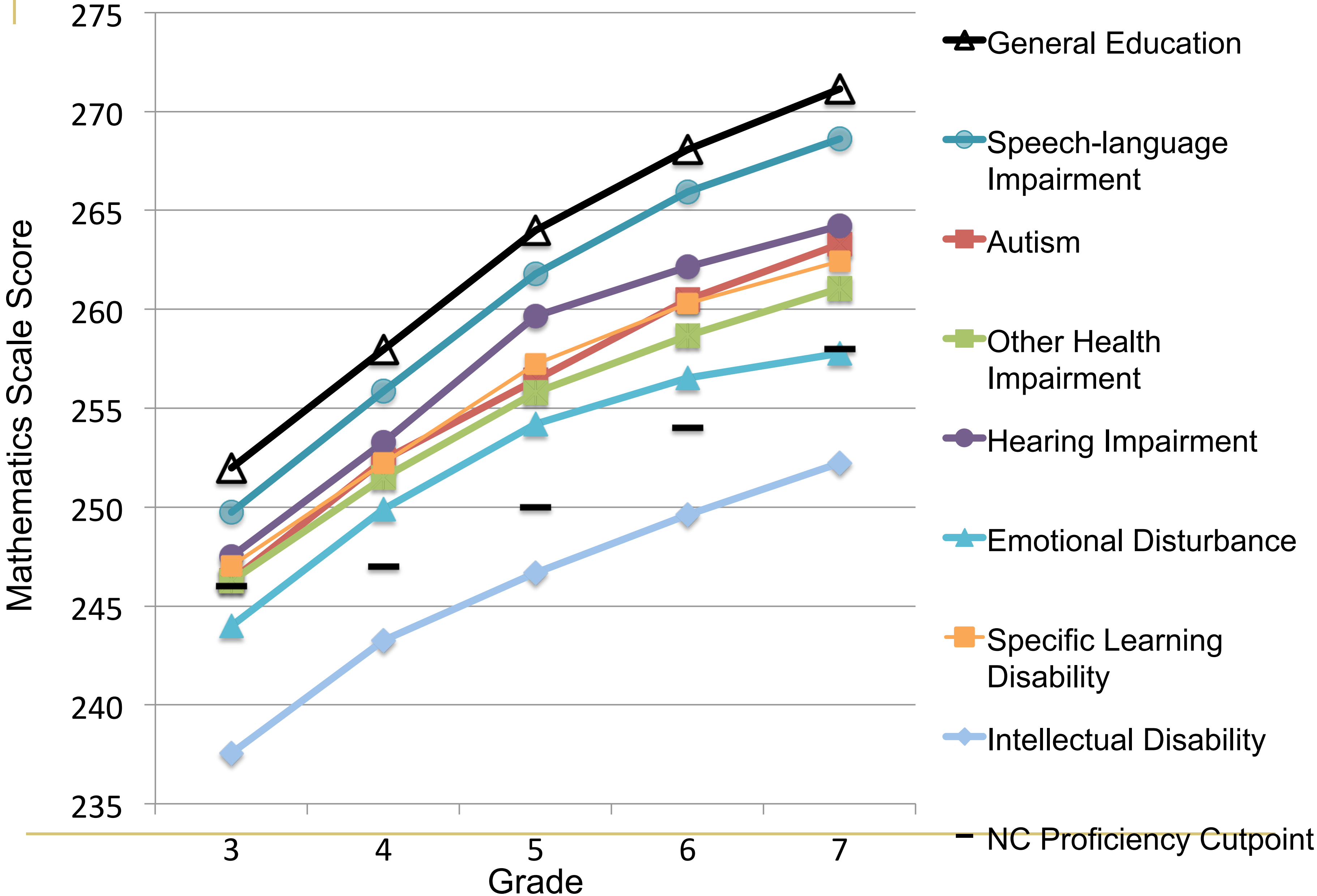
†Not significant, $p > .05$

Reading Two-level HLM (con't.)

Predictor		Intercept	Linear	Quadratic
Gifted-Rdg		7.82 (.08)	-0.59 (.06)	.09 (.01)
Gifted-Other		6.84 (0.15)	-0.54 (.12)	.08 (.03)
Autism		-7.80 (.74)	.38† (.41)	-.01† (.10)
Emotional Disturbance		-7.17 (.35)	1.00 (.23)	-.25 (.06)
Hearing Impairment		-8.89 (.65)	0.77† (.40)	-.15† (.10)
Intellectual Disability		-14.82 (.22)	1.38 (.18)	-.25 (.04)
Other Health Impairment		-7.86 (.22)	0.62 (.13)	-.13 (.03)
Specific Learning Disability-Rdg		-9.78 (.13)	1.72 (.08)	-.27 (.02)
Specific Learning Disability-Other		-4.96 (.25)	0.85 (.15)	-.18 (.03)
Speech-language Impairment		-2.64 (.15)	0.38 (.09)	-.06 (.02)
Pseudo R^2 (as %)		39.44	8.45	8.26

†Not significant, p >.05

Mathematics Growth by Exceptionality



Special Education Subgroup Membership Changes Across Time

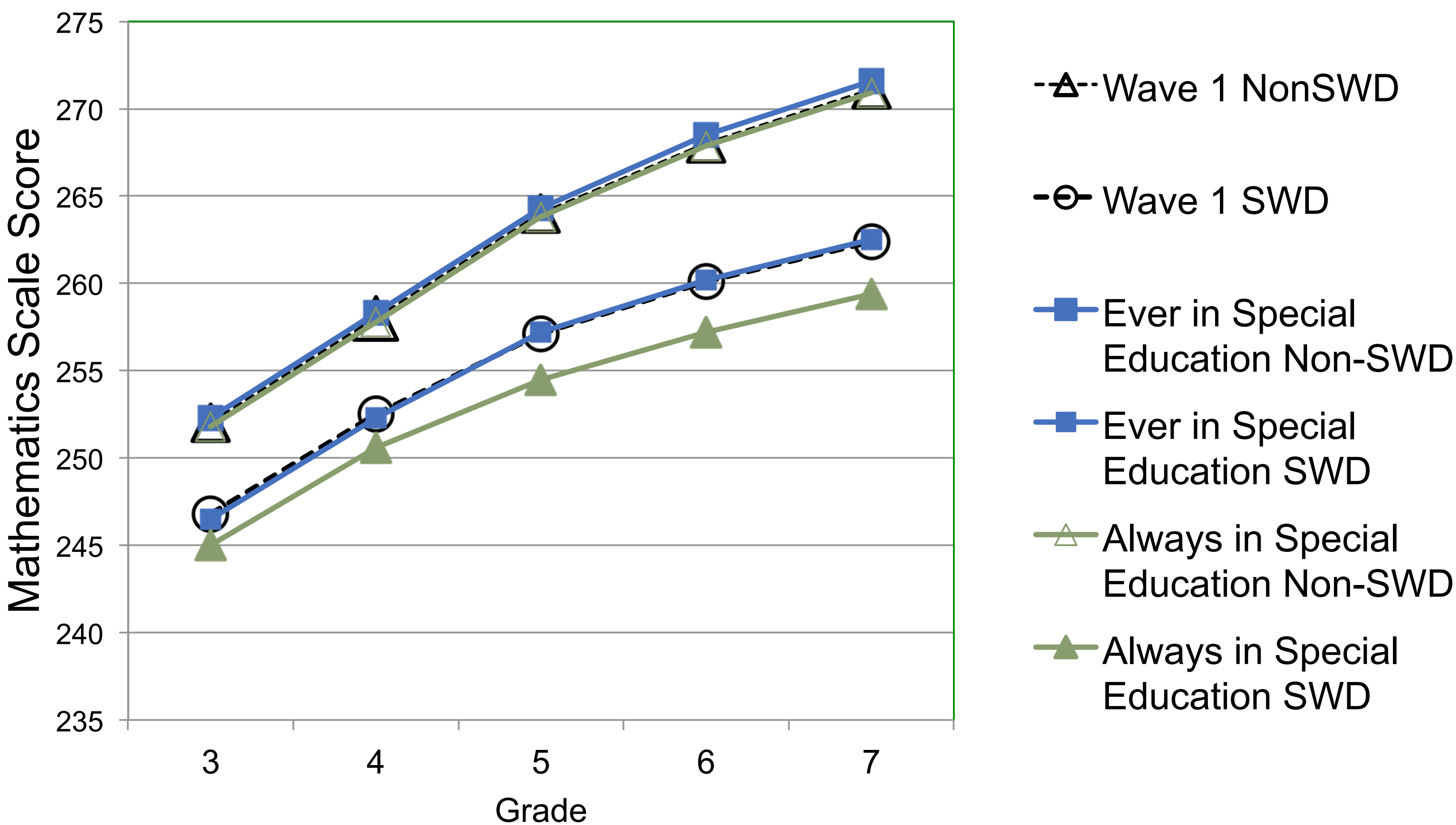
- Students exit and enter special education and changes are related to student achievement status.
- What are the implications of the changing membership?

Schulte, A. C., & Stevens, J. J. (2015). Once, sometimes, or always in special education: Mathematics growth and achievement gaps. *Exceptional Children, 81*, 370-387. doi: 10.1177/0014402914563695

Special Education Membership Grades 3-7

SWD Subgroup Identification Method	Percent
Current Year	11.1 to 12.4
Wave 1	11.8
Ever in Special Education	16.1
Always in Special Education	6.0

Observed Means by SWD Identification Method



Implications

- SWD subgroup is comprised of heterogeneous group of students, who vary greatly in achievement in grade 3
- Most exceptionality groups made somewhat greater growth than general education students in reading and somewhat less growth in mathematics—although overall characterization is one of stable gaps
- "One size may fit all" for growth, but only if differing starting points for SWD are recognized. Growth-to-standard expectations require much greater growth for most SWD groups than is typically observed

Individual Differences and Gaps for Students With Disabilities

Joseph Stevens
University Oregon

Individual Differences and Achievement Gaps in Math and Reading for SWD

- Summarize a number of our study results that focus on individual differences in academic performance
- Central NCLB and RTTT goal is universal proficiency and the reduction of achievement gaps between SWoD students and protected subgroups including SWD
- Previous research on achievement gaps has limitations:
  - Often gaps are not evaluated empirically; visual inspection rather than statistical testing; no common, empirical metric (effect size) to describe differences
  - Interactions not tested

SWD Growth Achievement Gaps

- What is the size of the achievement gap in mathematics and reading for students in specific exceptionality categories?
- Does the gap increase, decrease or stay the same over time?

Mathematics Achievement Gaps, see:

Stevens, J. J., Schulte, A. C., Elliott, S. N., Nese, J. F. T., & Tindal, G. (2015). Mathematics achievement growth of students with and without disabilities on a statewide achievement test. *Journal of School Psychology, 53*, 45-62.

Reading Achievement Gaps, see:

Schulte, A. C., Stevens, J. J., Elliott, S. N., Tindal, G., & Nese, J. F. T. (in press). Achievement Gaps for Students with Disabilities: Stable, Widening, or Narrowing on a State-wide Reading Comprehension Test? *Journal of Educational Psychology*.

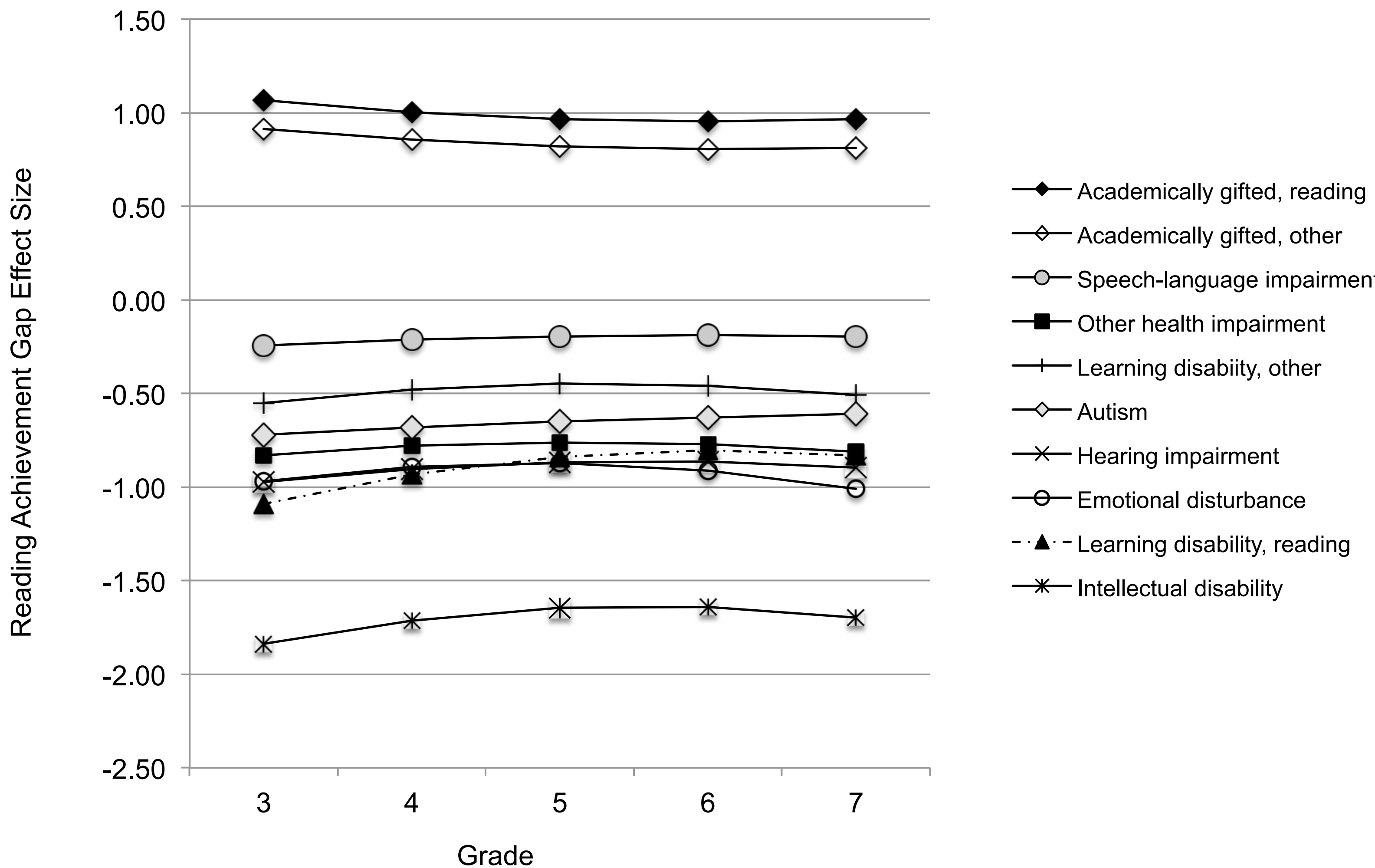


Figure. Reading achievement gap effect sizes based on differences in empirical Bayes estimated means across grades for students in different exceptionality categories compared to students in general education (from Schulte et al., in press).

Achievement Gaps as Differences in Proficiency Rates

- We also examined SWoD-SWD achievement gaps in other ways
- Difference in percent proficient (*P-P*)
  - Most common method in public dissemination (e.g., report cards); district, state, and federal reports
  - Easy to interpret?
  - *P-P* and Cohen's *h* reported below for North Carolina
- Problems with these metrics, however:
  - Size of gap depends on test used, score scale, and location of cutscore
  - Size of gap depends on shape of score distributions for the two groups
  - Proportions are ordinal, units may be different at different locations on the scale (i.e., not an interval scale)

North Carolina	Mathematics						Reading					
Grade	3	4	5	6	7	8	3	4	5	6	7	8
Student Group												
General Education	78.3	79.3	77.2	74.4	75.4	76.8	61.7	66.1	64.1	67.7	60.0	62.3
N	(97680)	(94162)	(92973)	(91406)	(90642)	(91668)	(97625)	(94111)	(92935)	(91370)	(90607)	(91627)
All SWD	53.2	49.9	45.3	39.7	38.5	39.9	30.8	32.1	27.8	28.5	23.0	24.1
N	(11208)	(11046)	(9934)	(9310)	(8728)	(8613)	(10759)	(10475)	(9466)	(9059)	(8510)	(8459)
h	.54	.63	.67	.72	.76	.77	.63	.69	.75	.81	.77	.79
Autism	62.4	64.9	59.7	62.1	64.8	57.4	41.9	48.3	50.6	47.2	51.6	47.4
N	(351)	(365)	(365)	(330)	(244)	(284)	(346)	(360)	(360)	(335)	(252)	(289)
h	.35	.32	.38	.27	.23	.42	.40	.36	.27	.42	.17	.30
Communication	67.3	66.3	59.7	51.8	51.2	48.4	46.6	50.8	43.2	42.8	32.2	29.1
N	(3842)	(2501)	(1354)	(651)	(369)	(223)	(3838)	(2496)	(1353)	(649)	(370)	(223)
h	.25	.29	.38	.47	.51	.60	.30	.31	.42	.51	.57	.68
Emotional	44.4	43.9	35.1	29.2	26.5	22.6	28.8	44.6	26.3	22.4	22.7	17.9
N	(331)	(394)	(453)	(510)	(475)	(562)	(323)	(166)	(453)	(510)	(476)	(570)
h	.71	.75	.88	.94	1.02	1.15	.67	.44	.78	.95	.78	.95
Hearing	49.0	50.0	56.0	46.7	41.0	44.1	20.6	30.9	32.3	34.3	21.9	24.1
N	(143)	(130)	(134)	(105)	(100)	(111)	(136)	(123)	(133)	(102)	(96)	(112)
h	.62	.63	.45	.58	.71	.68	.86	.72	.65	.68	.80	.79

	Mathematics						Reading					
Grade	3	4	5	6	7	8	3	4	5	6	7	8
General Education	78.3 (97680)	79.3 (94162)	77.2 (92973)	74.4 (91406)	75.4 (90642)	76.8 (91668)	61.7 (97625)	66.1 (94111)	64.1 (92935)	67.7 (91370)	60.0 (90607)	62.3 (91627)
Intellectual	7.9	4.8	3.7	4.4	4.2	6.1	1.7	3.2	2.8	2.2	0.0	1.7
N	(252)	(229)	(215)	(225)	(240)	(296)	(239)	(218)	(216)	(230)	(250)	(295)
h	1.60	1.76	1.76	1.66	1.69	1.64	1.55	1.54	1.52	1.63	1.59	1.56
Orthopedic	55.6	40.5	62.5	47.7	58.8	54.7	42.1	45.9	50.0	42.6	58.8	40.0
N	(36)	(37)	(48)	(44)	(34)	(53)	(38)	(37)	(48)	(47)	(34)	(55)
h	.49	.82	.32	.56	.36	.47	.39	.41	.29	.51	.02	.45
Other	44.1	41.7	38.5	36.0	33.8	36.7	24.7	27.7	26.7	29.9	22.2	25.6
N	(1663)	(2085)	(2218)	(2347)	(2299)	(2172)	(1625)	(2043)	(2204)	(2371)	(2313)	(2189)
h	.72	.79	.81	.79	.86	.83	.77	.79	.77	.78	.79	.76
Language Disability	47.1	46.4	45.5	40.8	40.9	43.6	19.6	24.2	22.7	26.1	21.9	23.7
N	(4524)	(5246)	(5085)	(5058)	(4909)	(4865)	(4148)	(4761)	(4638)	(4776)	(4662)	(4680)
h	.66	.70	.67	.69	.72	.69	.89	.87	.86	.86	.80	.80
TBI	30.0	–	35.3	38.5	36.8	20.0	–	–	43.8	25.0	15.8	6.7
N	(10)	(8)	(17)	(13)	(19)	(15)	(9)	(7)	(16)	(12)	(19)	(15)
h	1.01	–	.87	.74	.80	1.21	–	–	.41	.89	.95	1.30
Visual Impairment	62.8	75.0	57.1	60.9	62.9	74.1	50.0	53.3	57.1	39.1	54.3	46.2
N	(43)	(48)	(42)	(23)	(35)	(27)	(44)	(45)	(42)	(23)	(35)	(26)
h	.34	.10	.43	.29	.27	.06	.24	.26	.14	.58	.12	.32

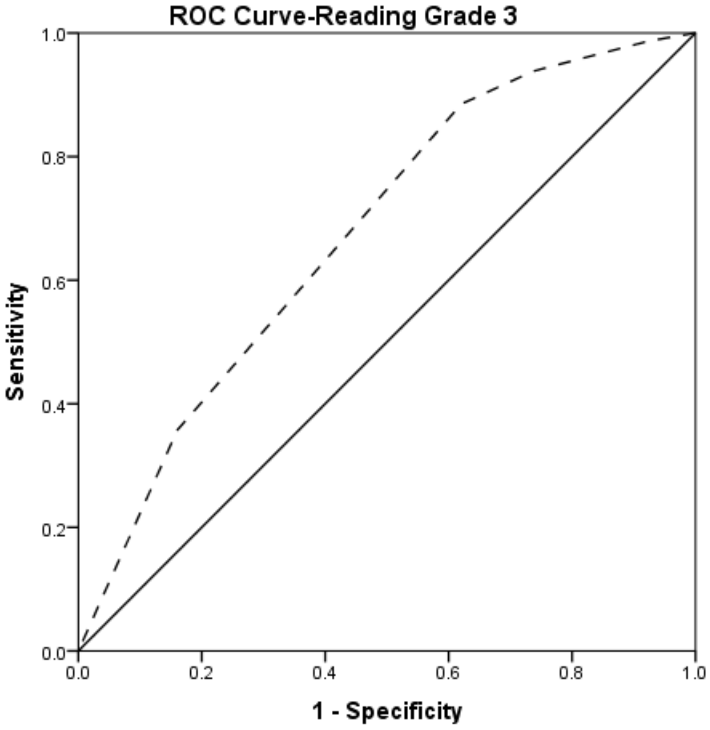
Achievement Gaps as Areas Between Score Distributions

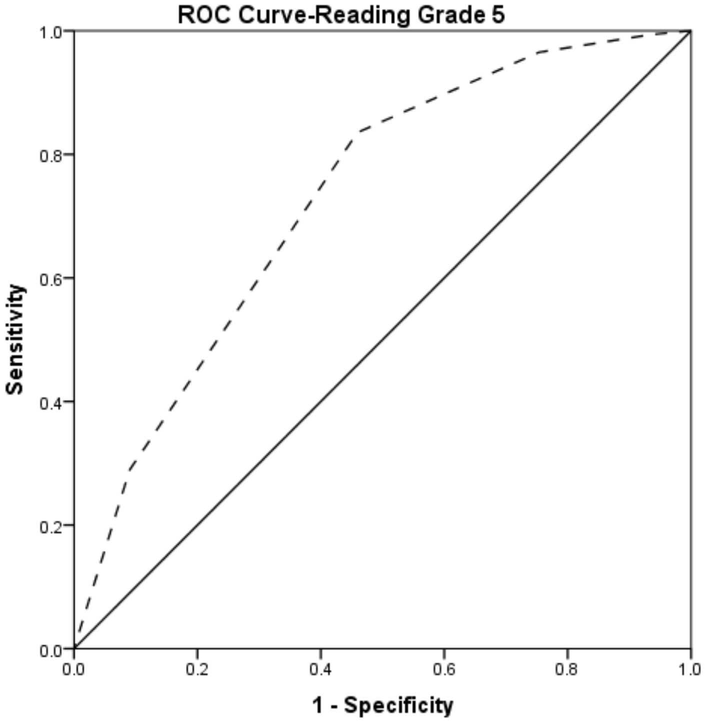
- A limitation of traditional ES measures is they only compare groups at the mean or at the proficiency cutpoint, possibly overlooking important group differences lower or higher on the score scale
- Alternatives are effect size measures based on nonparametric methods that examine group differences for all proficiency categories (see Ho & Reardon, 2012):
  - Area under the curve in Receiver Operating Curve (ROC) analysis
  - V' statistic
- Because of time constraints, we only report a few examples of ROC analysis

Whole distribution Achievement Gaps

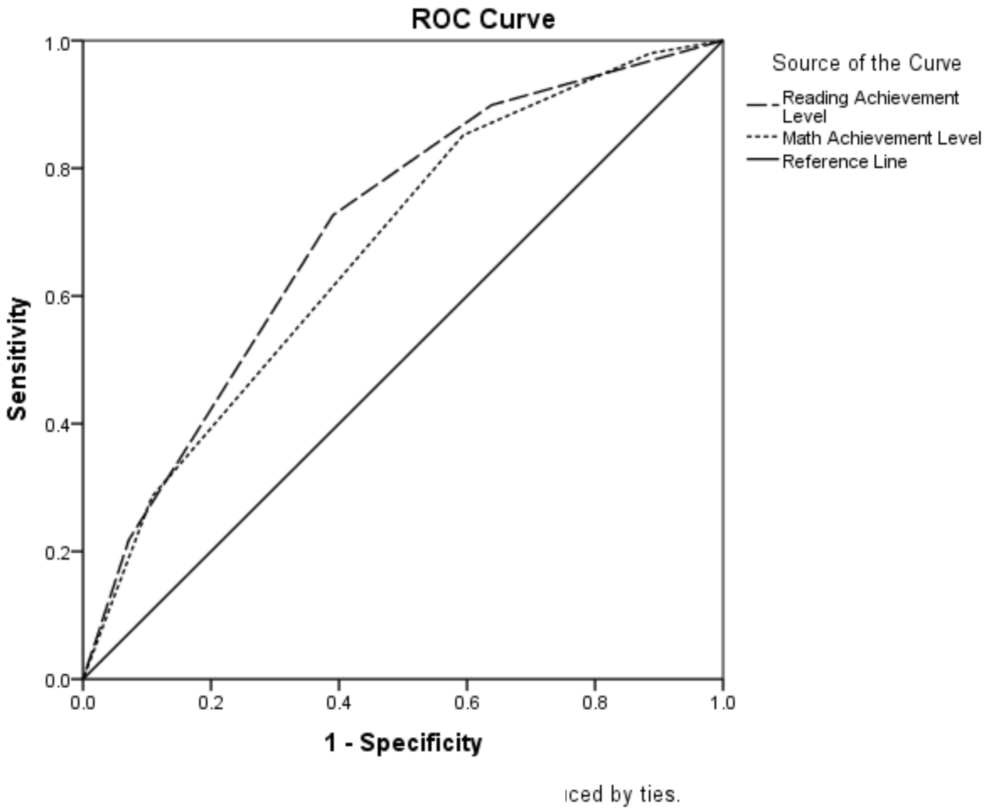
- ROC analysis (and V') uses nonparametric methods to address problems associated with characteristics of score distributions
- Advantage is estimation of gap across all proficiency levels
- ROC curve diagonal line represents no difference between reference group (SWoD) and focal group (SWD)
- Size of area between SWD group curve and diagonal is the area under the curve or the size of the difference between the two groups
- In following examples, note differences:
  - at different proficiency levels
  - for math vs. reading
  - by exceptionality subgroup

Achievement Gap for SWD vs. SWoD in Oregon Reading in Grade 3 (on left) and Grade 5 (on right)

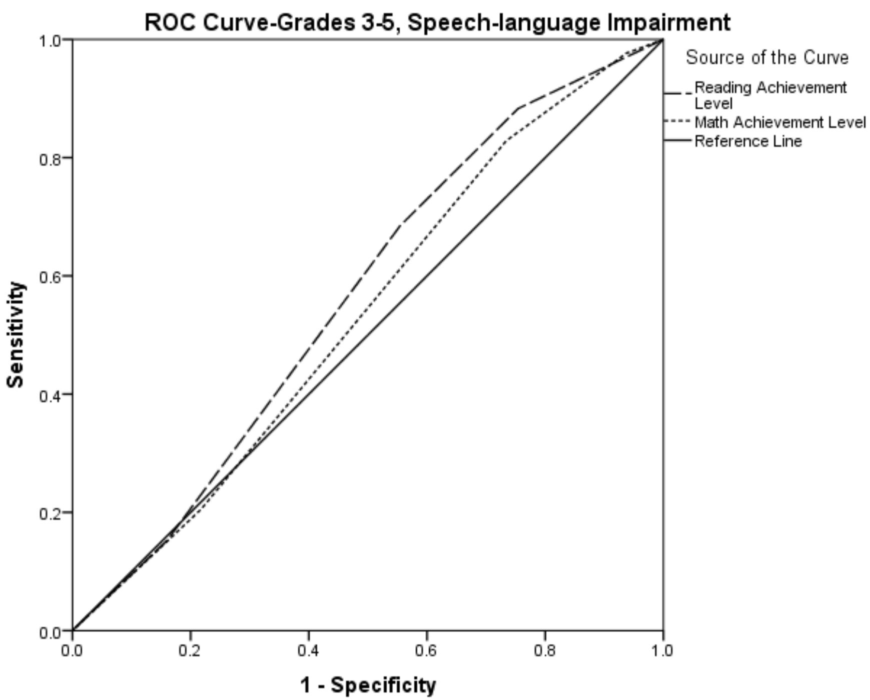


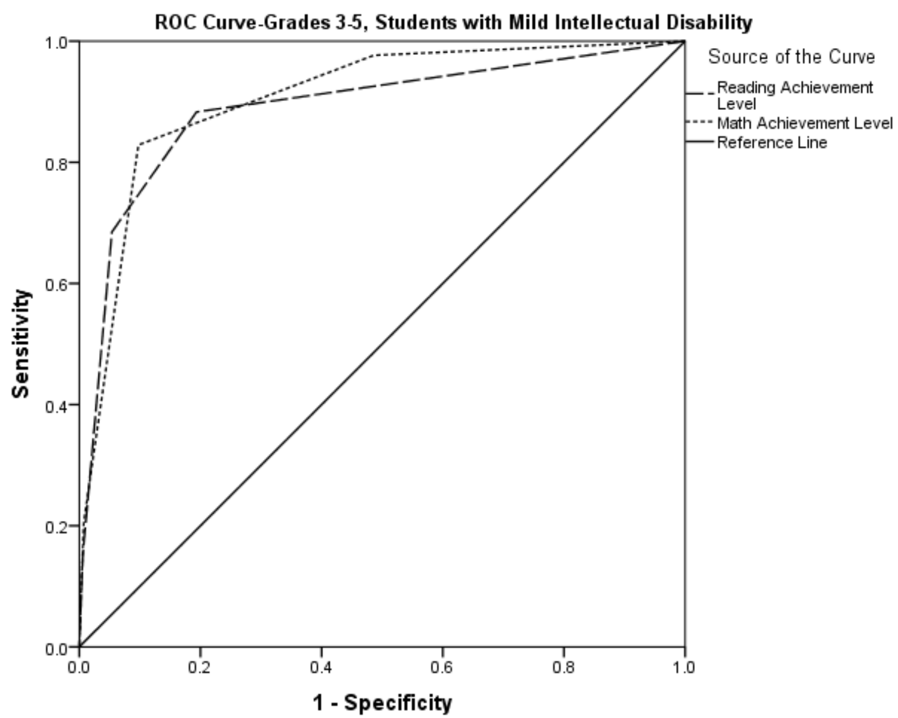


Achievement Gap for SWD vs. SWoD in NC Math and Reading Grades 3-5



Achievement Gap for SWoD vs. Speech-language Impairment (on left) or Mild Intellectual Disability (on right) on NC Math and Reading Grades 3-5





Interactions of SWD status and Other Student Characteristics

- Many studies do not directly test the interaction of SWD status and factors thought to be related to student performance (e.g., LD status and sex of student)
- When these factors are included in statistical models (especially regression and HLM models), only partial regression effects not the actual interactions are analyzed
- This can be very misleading and result in incorrect interpretations as well as incomplete understanding of achievement gaps

Stevens, J. J., & Schulte, A. C. (in press). The interaction of learning disability status and student demographic characteristics on mathematics growth. *Journal of Learning Disabilities*. DOI: 10.1177/0022219415618496

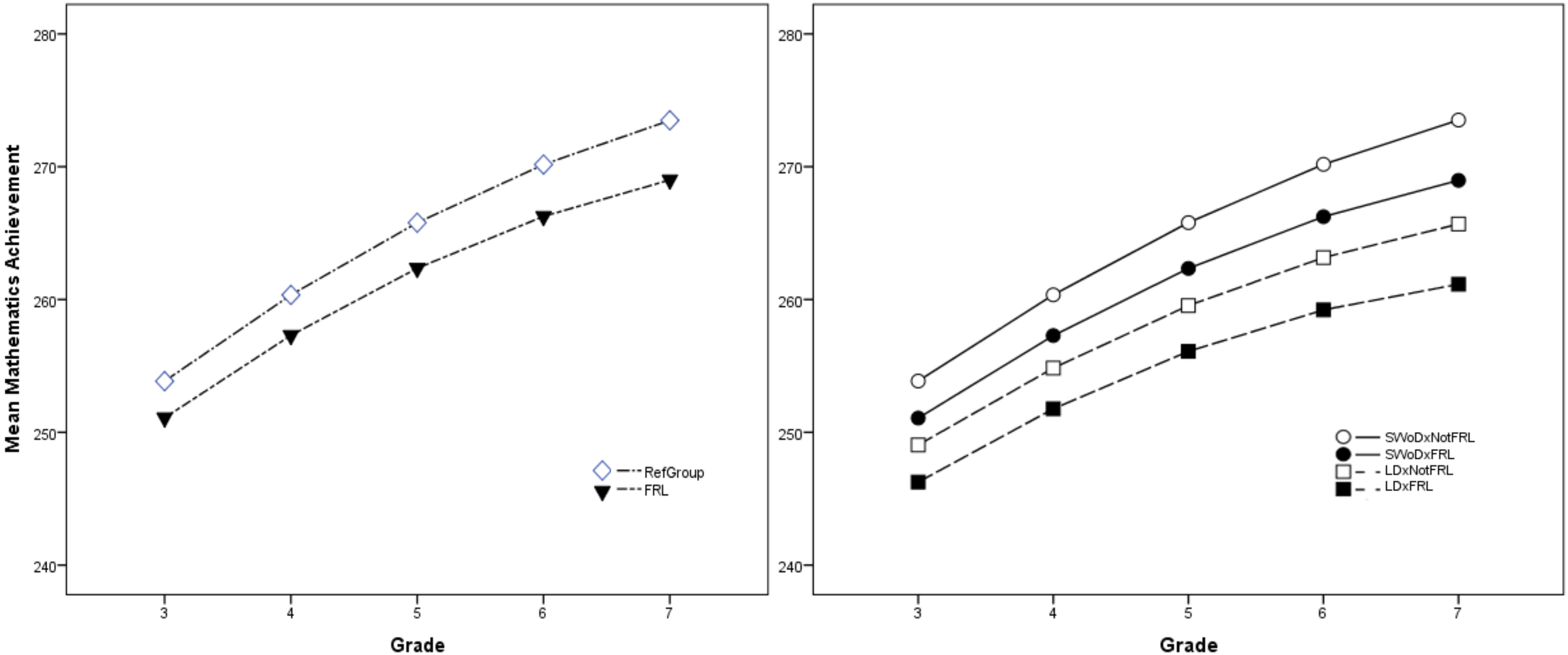


Figure. Partial regression of FRL compared to the reference group on left; three way interaction effect of LD x FRL x grade interaction on right.

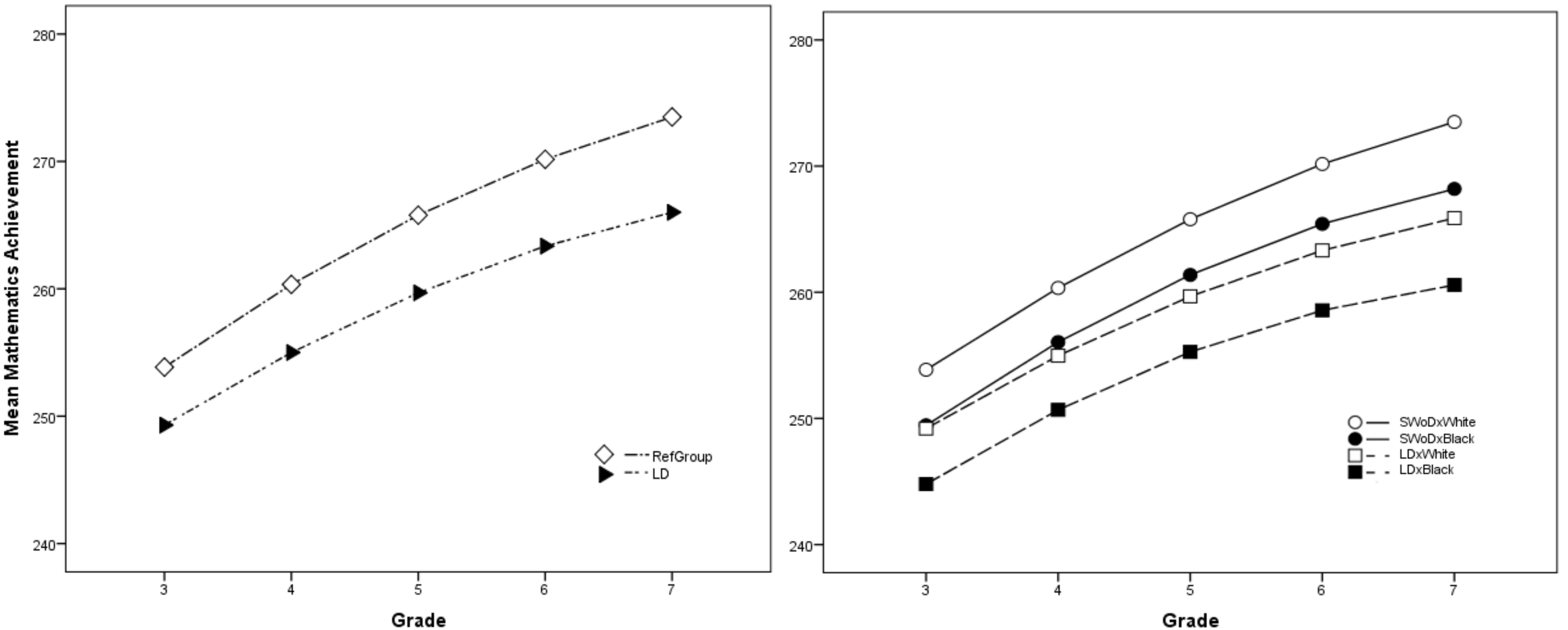


Figure. Partial regression of LD compared to the reference group on left; three way interaction effect of LD x Black race/ethnicity x grade interaction on right.

Mathematics Achievement Gaps for Elementary and Secondary Students:

The Influence of Opportunity to Learn and Special Education Status

Stephen N. Elliott
Arizona State University

NCAASE National Center on Assessment and Accountability for Special Education
Advancing research on growth measures, models, and policies for improved practice

Research Questions

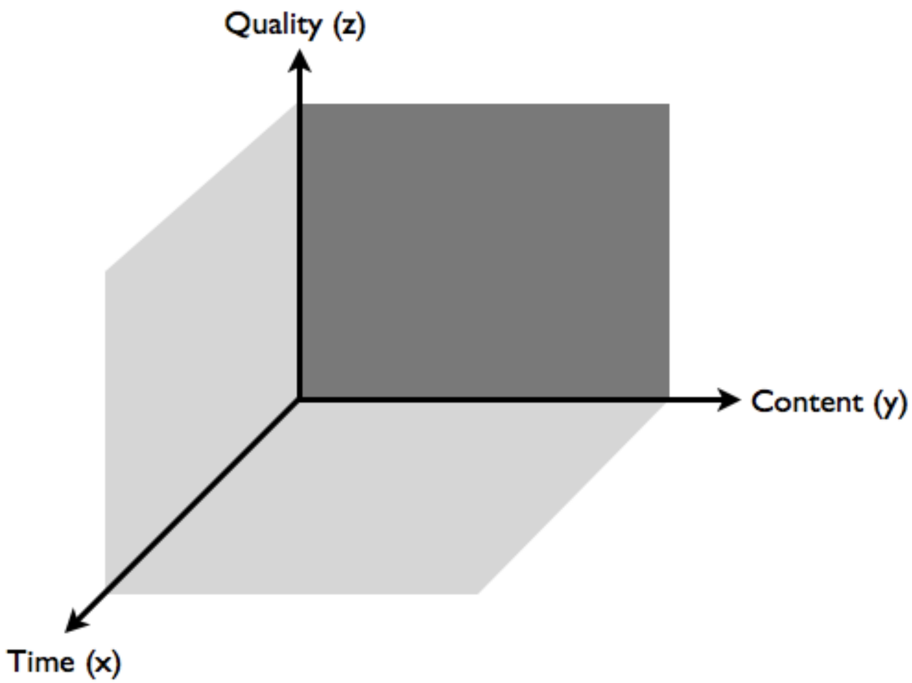
Specific research questions motivating the study were:

1. Do students with and without disabilities who received instruction in the same general education classrooms have an equal opportunity to learn mathematics?

2. What is the relationship among five instructional variables (characterized as OTL) and within year academic growth on an interim assessments?

3. What is the predictive relationship among five instructional OTL variables and students' end-of-year mathematics achievement?

Opportunity to Learn (OTL) the Intended Curriculum



A unified conceptualization of OTL
ased on 50+ years of empirical research.

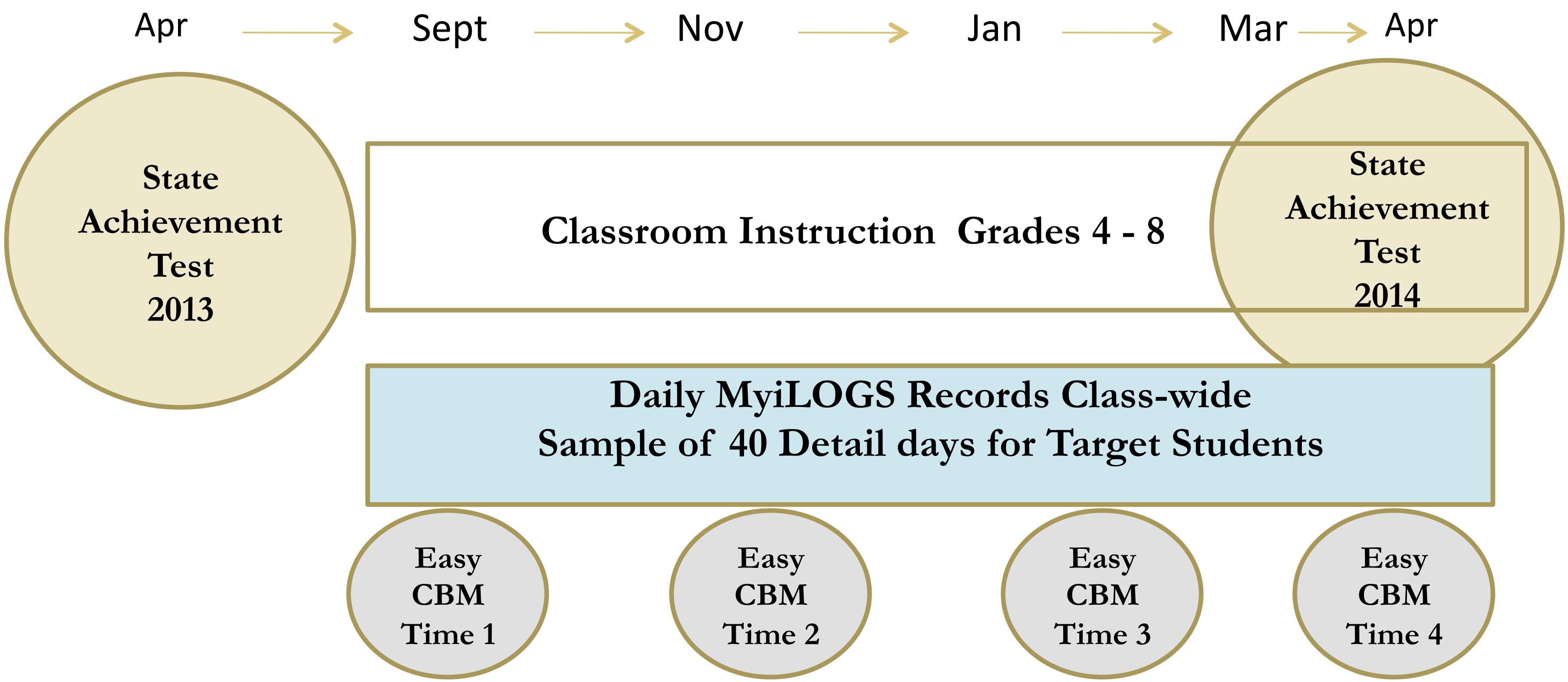
Definition: Opportunity to Learn

The degree to which a teacher dedicates instructional time and content coverage to the intended curriculum objectives emphasizing higher-order cognitive processes, evidence-based instructional practices, and alternative grouping formats.

(Kurz, 2011)

Multiple Measures Study Design*

Teachers (N = 78; AZ 49, OR 29) and students (N = 327; 162 SWD + 165 SWoD) from AZ & OR schools grades 4th-8th



*A 3-year study with longitudinal student cohorts

Summary of Year 1: Key Findings

- We observed very similar instructional processes for students with and without disabilities learning mathematics in the same elementary or secondary classrooms in AZ and OR schools. Significant achievement gaps between these groups of students, however, existed on the four interim CBM assessments and the end-of-year achievement state test.

- We found that the collection of five MyiLOGS scores, along with grade level and special education status, accounted for a substantial amount (i.e., 43% to 44%) of the variance in student's end-of-year mathematics scores. A subset of OTL indices explained a statistically significant, although relatively small portion of unique variance in the end-of-year mathematics scores. The particular OTL scores found to be significant contributors varied across AZ and OR.

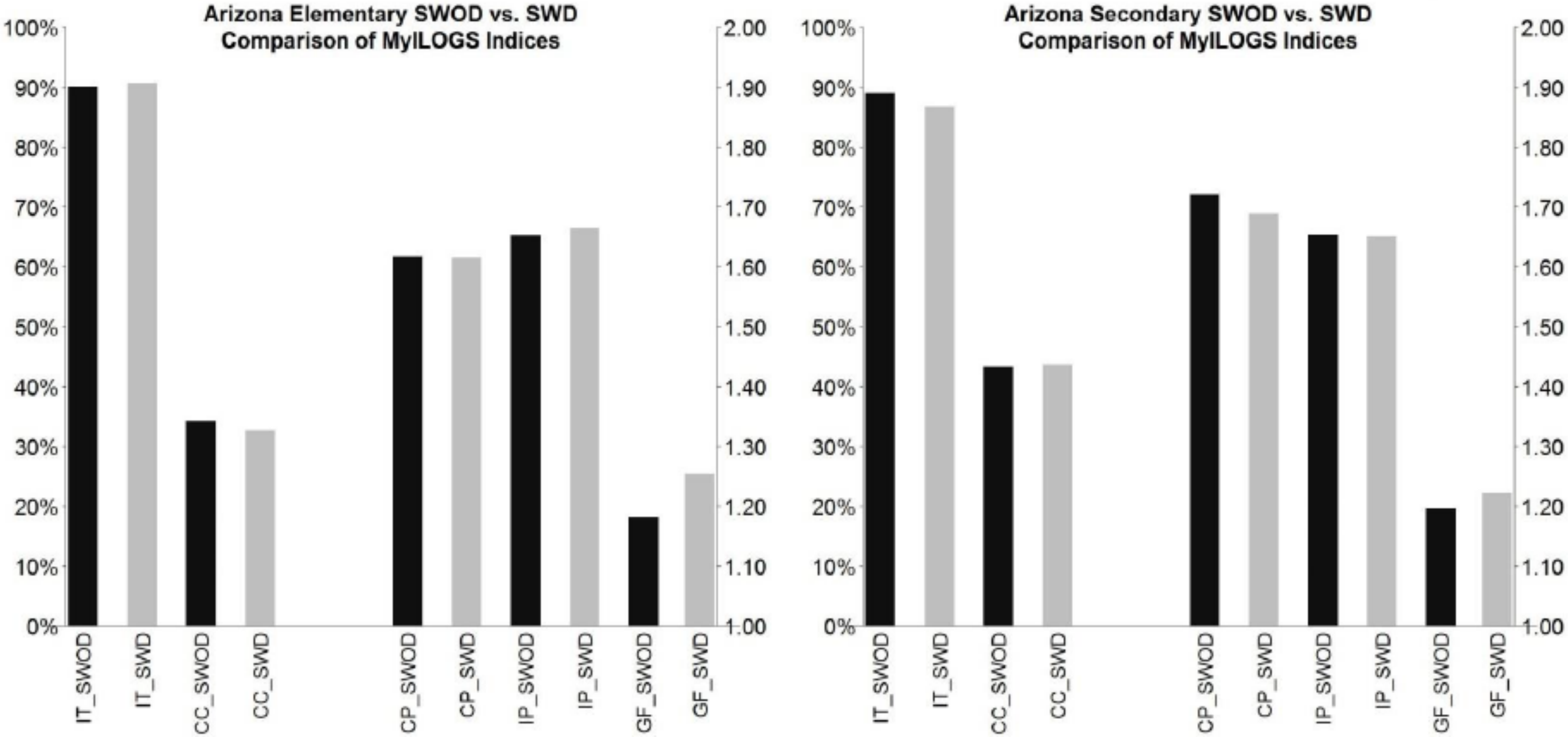
Year 2 Findings

- AZ teachers reported an average of 164 days and OR teachers reported 158 days of instruction; 25% of these days were Detail Days where instructional information on cognitive processes, practices, and grouping for SWD and SWOD was documented. Based on these Detail Days, we observed **very similar mathematics instructional processes for students with and without disabilities in the same elementary or secondary classrooms** in AZ and OR schools. Yet, there were **significant achievement gaps between these groups of students** on the four interim CBM assessments and the end-of-year achievement state test.

- We also found that Grade Level and Special Education Status, along with the collection of five MyiLOGS scores, accounted for a substantial amount (i.e., 30% OR, 39% AZ) of the variance in student's end-of-year mathematics scores. OTL indices explained a relatively small portion of unique variance in the end-of-year mathematics scores.

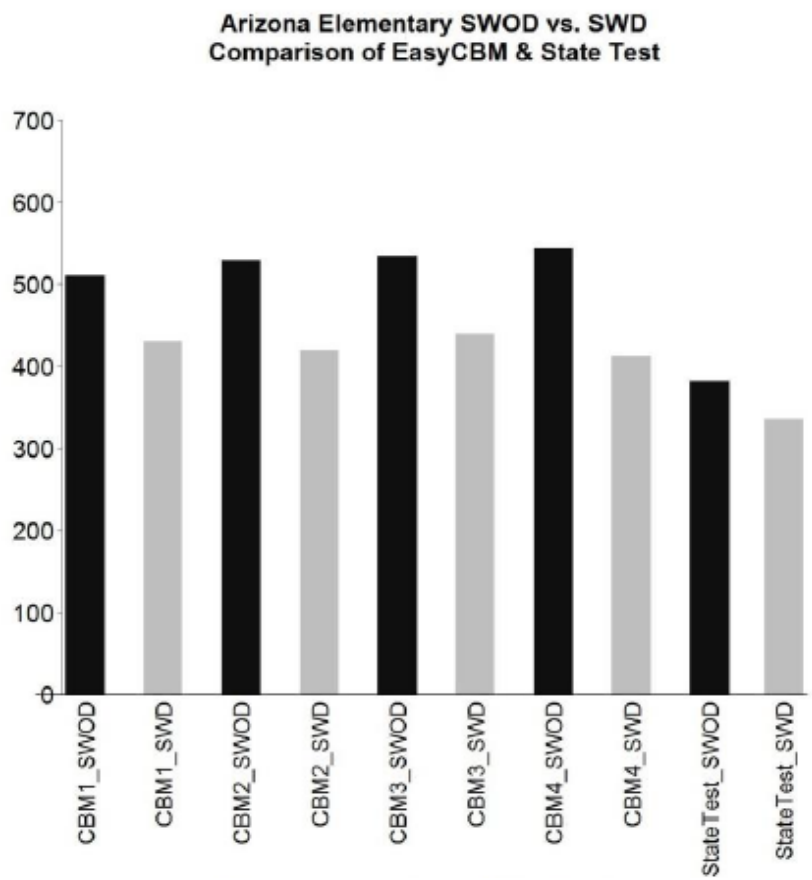
- ICCs (Teacher-Observer) for Observations on 6 random Detail Days each Year:
  InstrTime = .80; CogProcess = .28; InstrPractice = .39; GroupFormat = .45

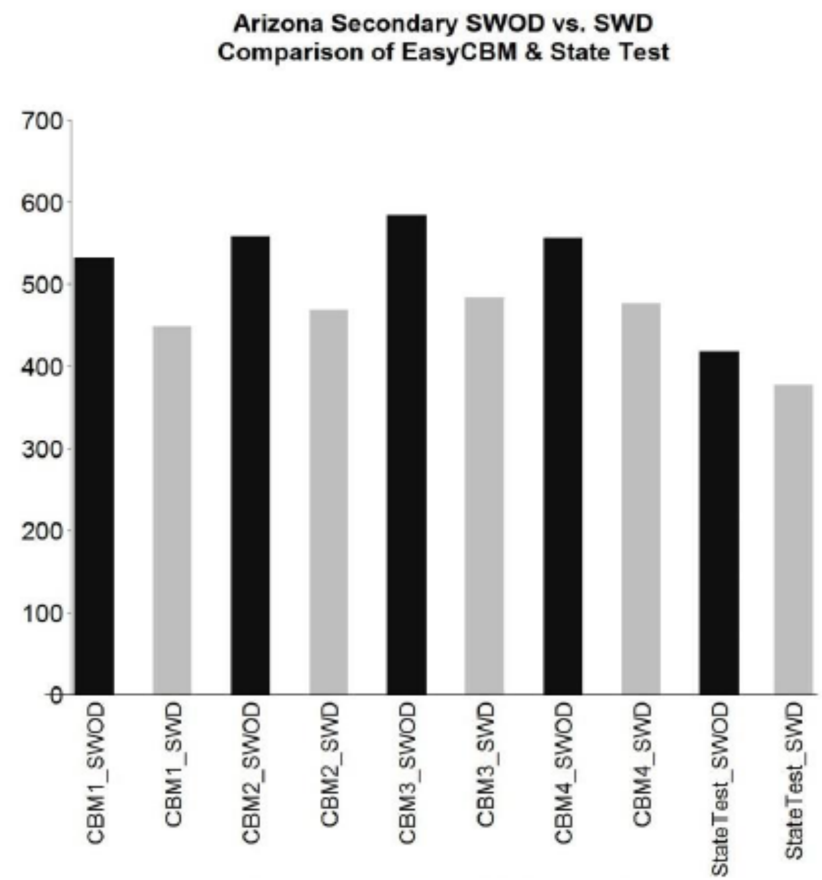
Comparison of OTL Indices for AZ Students



SWOD Black **SWD Gray**

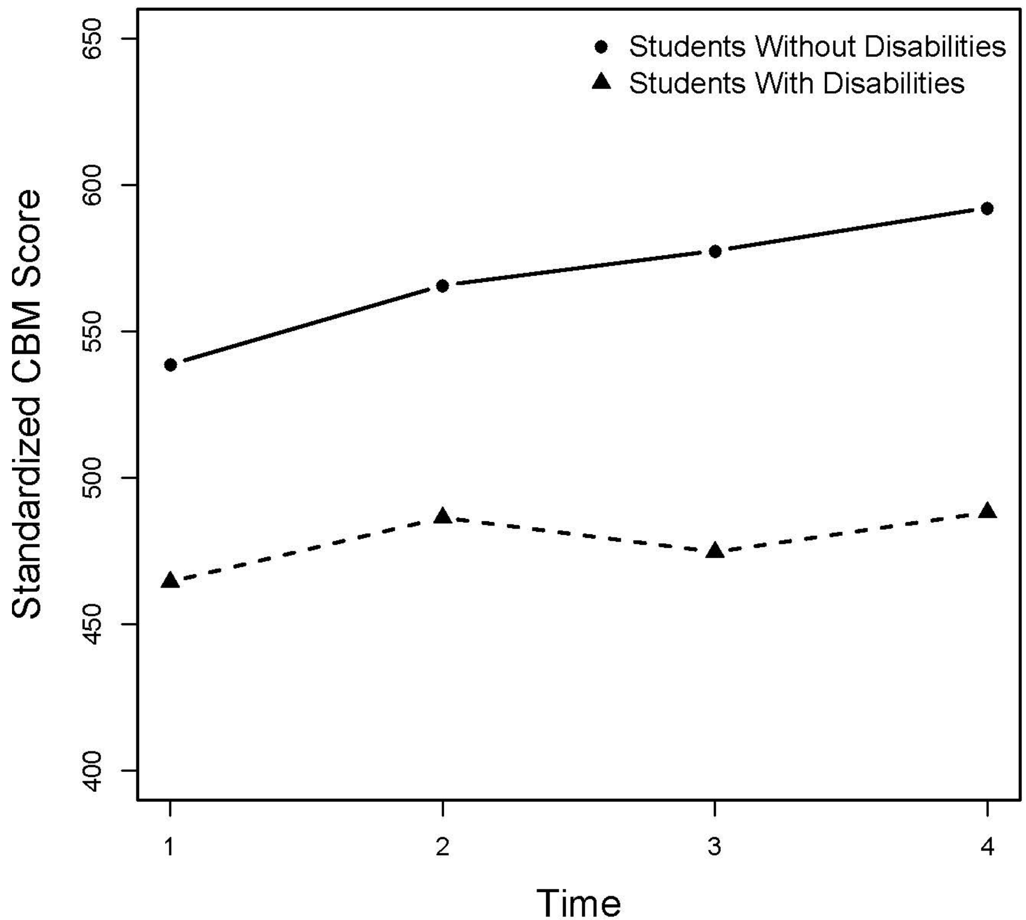
Comparison of Interim & End-of-Year Test Results for AZ Students





SWOD Black **SWD Gray**

Within Year Standardized Mathematics CBM Growth



Conclusion

Offering students with disabilities the same amount of instruction on the same content standards in the same general education classrooms was found to offer **the same historic results—large and persistent gaps in achievement -- in comparison to students without disabilities.**

The findings in Year 2 replicated those from Year 1. Thus, it indicates that students with disabilities will need more instructional time on the intended curriculum, and perhaps more differentiated instruction to increase their rate of achievement enough to close gaps that currently exist between them and students without disabilities.

Within Year Growth

Drs. Tindal and Nese
University of Oregon

Measurement Sufficiency

- RTI within classrooms using CBMs to screen with tiers of support
- Grades 3-5 with oral reading fluency
- Benchmark and progress monitoring
- Teacher decision making on grade level of measures
- Multi-level model with
  - Time
  - Student characteristics
  - Measurement characteristics
- Major Findings

Measurement Sufficiency

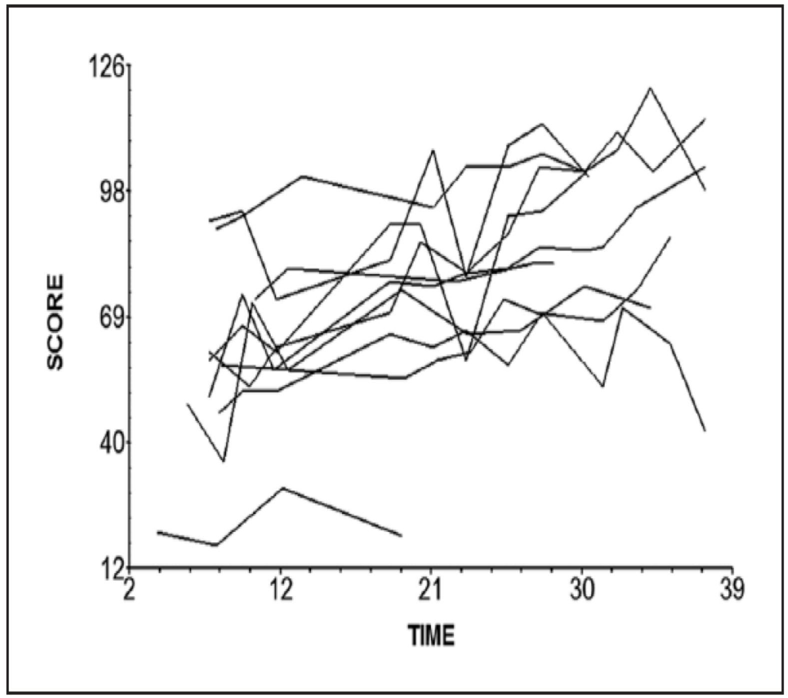


Figure 1. Plot of a random sample (.05%) of students' progress monitoring unconditional growth.

Measurement Sufficiency

Table 4. Final Conditional Model With Special Education Status and Measurement Condition.

Fixed effect	Coefficient	*SE*	*t* ratio	*df*	*p* value
Grade 3					
Intercept, β_{00}	88.23	1.286	68.61	1278	<.001
Special education, β_{01}	−19.70	3.041	−6.48	1278	<.001
Sufficient measurement, β_{02}	−21.72	2.23	−9.74	1278	<.001
Slope, β_{10}	0.67	0.03	20.87	1278	<.001
Special education, β_{11}	0.08	0.12	0.67	1278	.505
Sufficient measurement, β_{12}	0.16	0.05	2.99	1278	.003
Grade 4					
Intercept, β_{00}	107.56	1.09	98.69	1235	<.001
Special education, β_{01}	−23.71	2.70	−8.79	1235	<.001
Sufficient measurement, β_{02}	−19.89	2.14	−9.31	1235	<.001
Slope, β_{10}	0.62	0.03	24.31	1235	<.001
Special education, β_{11}	0.01	0.05	0.16	1235	.872
Sufficient measurement, β_{12}	0.12	0.04	2.71	1235	.007
Grade 5					
Intercept, β_{00}	133.24	1.30	102.37	1094	<.001
Special education, β_{01}	−28.42	2.70	−10.53	1094	<.001
Sufficient measurement, β_{02}	−18.27	2.53	−7.22	1094	<.001
Slope, β_{10}	0.70	0.03	21.93	1094	<.001
Special education, β_{11}	−0.08	0.05	−1.53	1094	.126
Sufficient measurement, β_{12}	−0.10	0.05	−2.03	1094	.043

30 Years of Research on ORF

- Initial findings in 1984 – Pine County Norms
- Fuchs and Deno estimates of growth
- Deno and Shin estimation with a 'national sample'
- Recent studies with large data sets
  - Hasbrouck and Tindal publications
  - Florida studies
  - easyCBM

30 Years of Research on ORF

Table 1

Comparison of Studies on Research Variables Referenced in Studying Growth of Reading Fluency

Authors (date)	Grades	Students	Measures	N-Measures	Slope Calculation	Averages and Growth – WCPM
Marston, Lowry, Deno, & Mirkin (1981)	Grades (n): 1 (13), 2 (9), 3 (10), 4 (7), 5 (7), 6 (9)	Students from a small Midwest city	Third grade basal reading series: Allyn-Bacon, Ginn 720, Houghton Mifflin	Three administrations: Fall, winter, and spring	Plot of raw scores and percentage of change; significance tests of differences	Grades / Fall / Winter / Spring 1 / 18.1 / 31.1 / 45.7 2 / 73.2 / 101.1 / 127.8 3 / 108.3 / 123.6 / 136.2 4 / 125.4 / 131.7 / 155.3 5 / 125.7 / 147.3 / 161.1 6 / 142.9 / 176.7 / 182.8
Tindal, Germann, Marston, & Deno (1983)	Grades (n): 1 (5), 2 (13), 3 (17), 4 (22), 5 (18), 6 (21)	Students from six districts referred, assessed, and eligible for special education	Curricula in use in the school district	Three administrations: Fall, winter, and spring	Change in raw score and in discrepancy from general education	Grades / Fall / Winter / Spring 1 / 6.8 / 14.3 / 9.6 2 / 5.5 / 16.2 / 23.6 3 / 20.5 / 36.6 / 41.3 4 / 31.0 / 50.3 / 52.9 5 / 59.1 / 72.9 / 79.1 6 / 59.5 / 65.9 / 66.8
Tindal, Germann, & Deno (1983)	Grades (n): 1 (276) 2 (284) 3 (302) 4 (294) 5 (315) 6 (328)	Students randomly sampled from six districts in Pine County	Two passages sampled from basal reading curriculum	Three administrations: Fall, winter, and spring	Change in raw scores	Grades / Fall / Winter / Spring 1 / 5 / 63 / 75 2 / 35 / 83 / 93 3 / 67 / 89 / 108 4 / 98 / 111 / 128 5 / 121 / 120 / 138 6 / 123 / 126 / 134
Fuchs, Deno, & Mirkin (1984)	Grades 3-5: 64 students in (DBPM) 77 students in no DBPM	All students were 'handicapped'	3rd grade passage reading test from Ginn 720	Pre-post (unknown: sometime between Nov. and May)	Pre-post difference @ 28 weeks	Condition* / Pre / Post Experimental* / 41.6 / 70.2 Contrast / 51.5 / 51.3 *DBPM versus none*

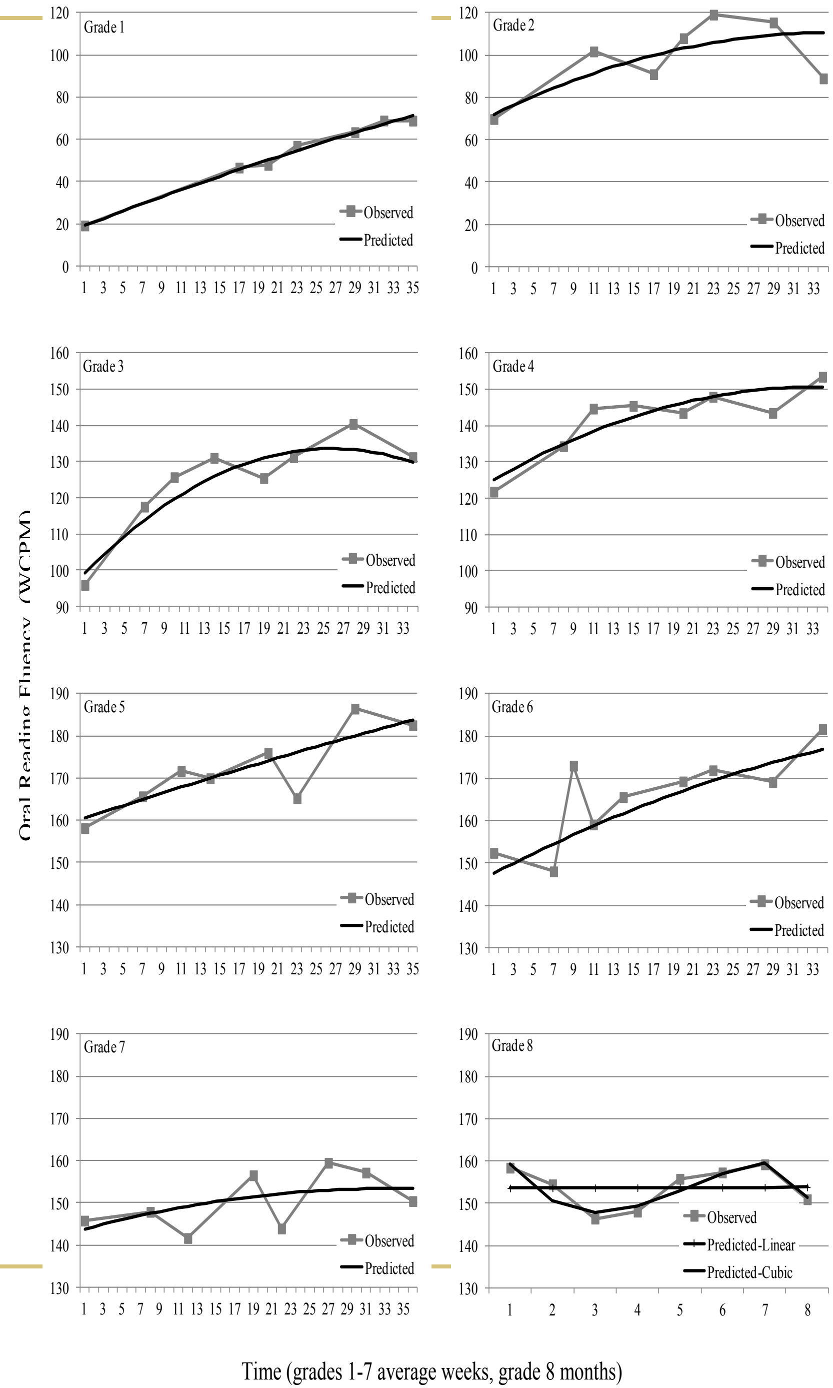
30 Years of Research on ORF

Authors (date)	Grades	Students	Measures	N-Measures	Slope Calculation	Averages and Growth – WCPM
Al Otaiba, Petscher, Pappamihiel, Williams, Dyrlund, & Connor (2009)	Grades 2- 3: 5,004 Latino students	(a) Proficient in English, (b) Not proficient and receiving English as a second language (ESL) services, and (c) Proficient enough to have exited from ESL	**DIBELS** (Good & Kaminski, 1996)	Four administrations: first 20–30 days of school (Sep); between the 65th and 75th days of school (Nov); between the 110th and 120th days of school (Feb); and between the 155th and 165th days of school (Apr).	Two level HLM with growth centered on the first testing time in third grade (September) and student characteristics (i.e., language group and special education subgroup) were entered at Level 2 designed to model both second- and third-grade growth trajectories	Grade 2 Weekly Growth: Proficient / ESL / ESL-exit GE 1.2 / .8 / 1.2 LD 1.2 / .8 / 1.1 SL 1.3 / .9 / 1.1 Grade 3 Weekly Growth: Proficient / ESL / ESL-exit GE 1.2 / 1.1 / 1.3 LD 1.3 / 1.1 / 1.3 SL 1.2 / 1.1 / 1.2
Ardoin & Christ (2009)	Grades 2-3: 28 and 40 respectively	Race and free or reduced-price lunch reported for students in each of two schools	Three passage sets: (a) FAIP-R, (b) AIMSweb, and (c) **DIBELS**	12 weeks (with approximately 2 administrations per week) with time of year unknown	Ordinary least square (OLS) regression used to calculate an intercept and slope for each passage set	Intercept / Slope* FAIP-R 84.8 / 1.4 AIMSweb 94.3 / 1.8 DIBELS 100.4 / .5 **Slope times 7 to estimate weekly gain*
Crowe, Connor, & Petscher (2009)	Grade 1 (n=9,993), Grade 2 (n=9,869), Grade 3 (n=10,141)	Lower SES (eligible for free or reduced price lunch) and non lower SES students	**DIBELS** (Good & Kaminski, 2002).	Two administrations in September and April	Hierarchical Linear Modeling (HLM) to estimate mean growth trajectories for curriculum interacting with SES over the school year (7 months)	Sept. / April Grade 1 18 / 50 • Higher SES 25 / 63 • Lower SES 16 / 46 Grade 2 53 / 89 • Higher SES 63 / 77 • Lower SES 50 / 62 Grade 3 73 / 101 • Higher SES 85 / 113 • Lower SES 69 / 97 **Curriculum differences reported that interacted with students SES.*

PRF WITHIN all Grades

- Rates of growth in research and aim lines in practice are used to characterize student growth; in either case, growth is generally defined as linear, increasing at a constant rate over time.
- Linearity assumption may be inaccurate.
- We examined ORF growth within-year for students in Grades 1-8.
  - Other research limited by using only 3 testing occasions.
  - Our sample included Grade 1 to 8 students, drawn from the full range of abilities within each grade level and assessed up to 8 times per year.

- Comparing the trajectories across grades, we found that a decelerating growth curve best described ORF data.
- On average, across grades, students exhibit a decrease in growth across the year.



Nese, Biancarosa, Cummings, Kennedy, Alonzo, Tindal. In search of average growth: describing within-year oral reading fluency growth for grades 1-8. *Journal of School Psychology.*

NCAASE National Center on Assessment and Accountability for Special Education

Advancing research on growth measures, models, and policies for improved practice

PRF within GRADE 4

- The purpose of this study was to demonstrate ways to model nonlinear growth using three testing occasions: fall, winter, and spring passage reading fluency benchmark assessments.
- 2,100 Grade 4 students.
- Passage reading fluency (PRF)

PRF Within GRADE 4

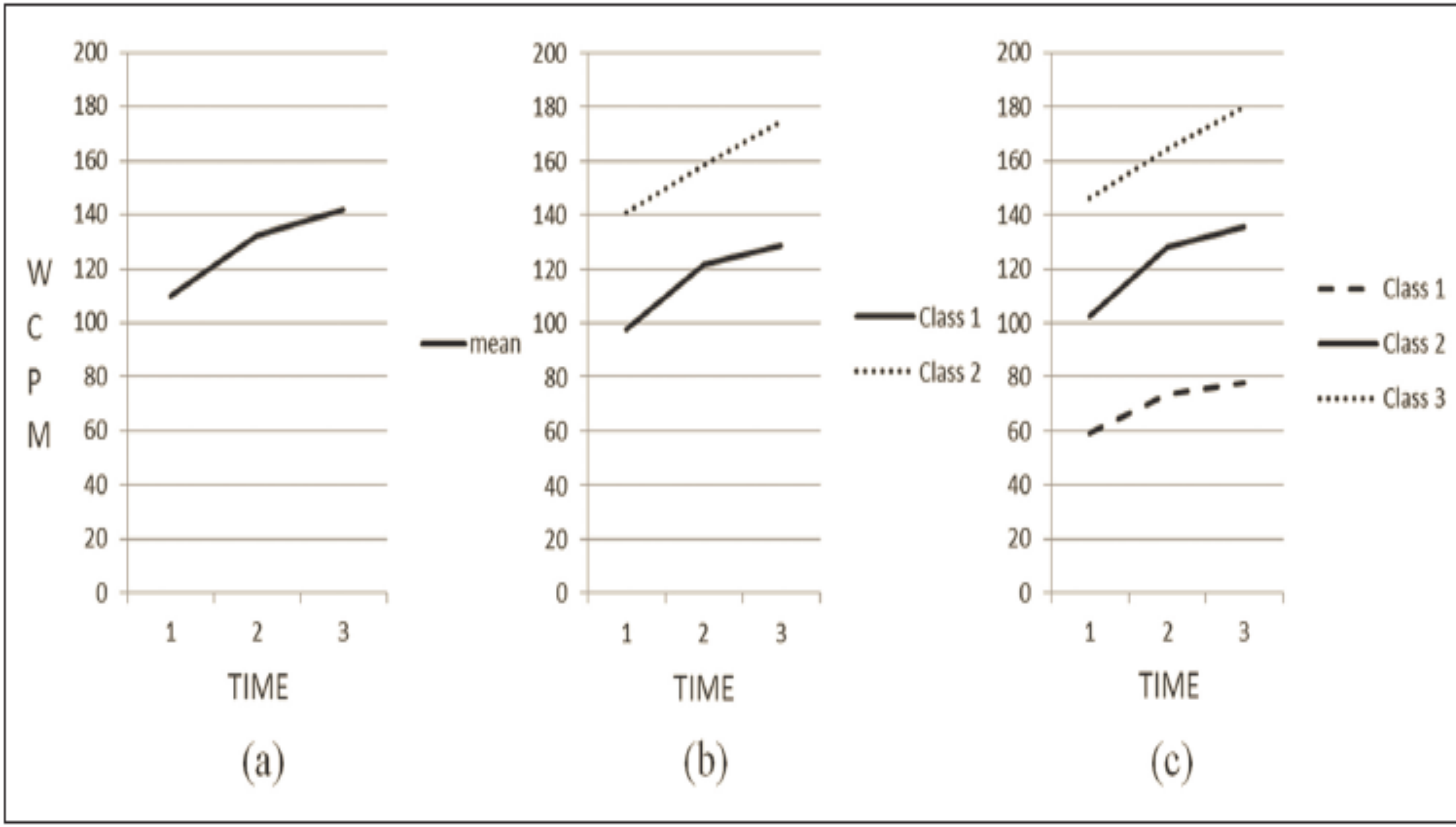
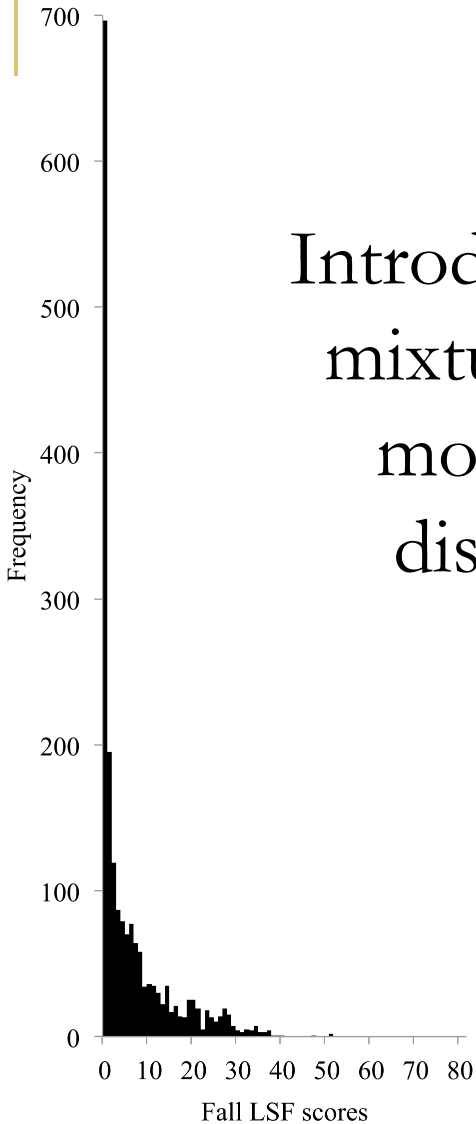


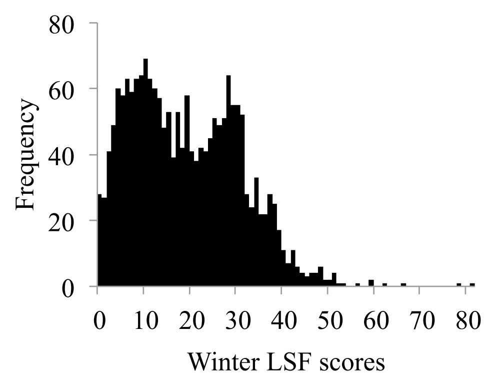
Figure 3. Estimated growth patterns for 1-class PGM and 2-class and 3-class piecewise growth mixture models (PGMM).

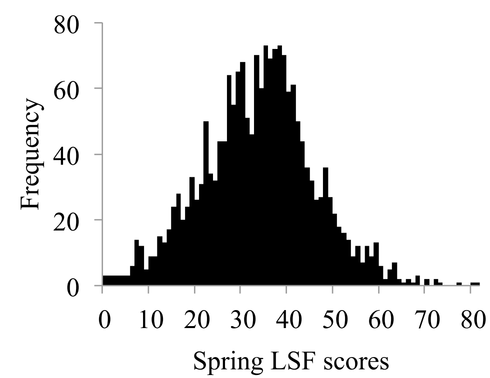
Kamata, Nese, Patarapichayatham, Lai. Modeling Nonlinear Growth With Three Data Points: Illustration With Benchmarking Data. *Assessment for Effective Intervention.*

Purpose

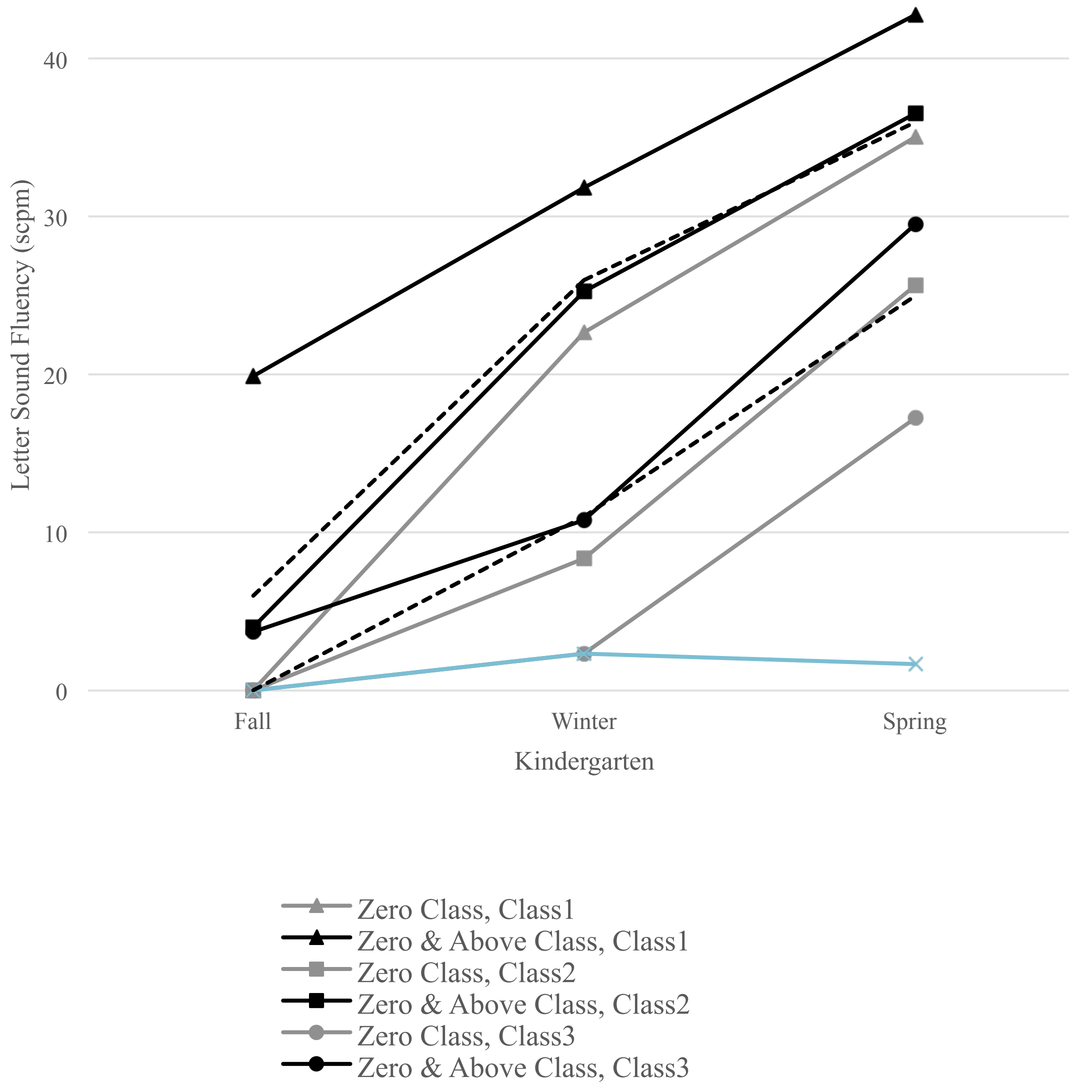
Introduce and apply a two-step growth mixture model (GMM) approach for modeling repeated measures with distributions changing over time.







Results



Letter Sound Fluency (scpm)
40
30
20
10
0
Fall
Winter
Spring
Kindergarten
Zero Class, Class1
Zero & Above Class, Class1
Zero Class, Class2
Zero & Above Class, Class2
Zero Class, Class3
Zero & Above Class, Class3

Growth Models for School Effects

Joseph Stevens
University Oregon

Models Evaluating School Level Growth

- Comparison of different models of estimating school performance using OR, AZ, NC, and PA state data
- Models include:
  - status; gain and residual scores
  - transition matrix models
  - value-added models
  - Student Growth Percentiles (SGP)
  - Hierarchical linear growth models (HLM)
- Model variations include: (a) three cohorts; (b) two grade levels, elementary (Grades 3-5) and middle (Grades 6-8), and (c) unconditional vs. conditional models (school size, student composition of school)

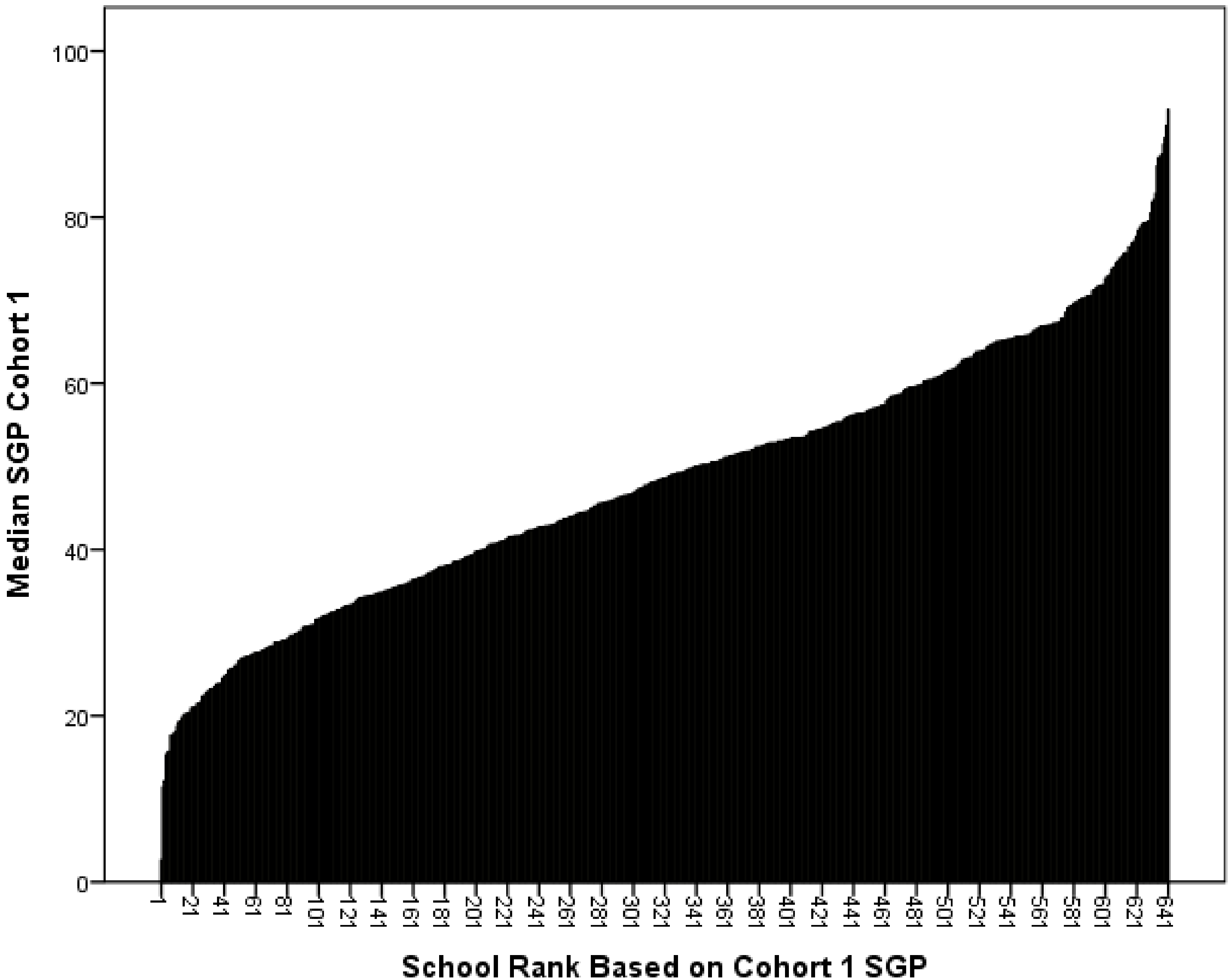
Some Preliminary Results

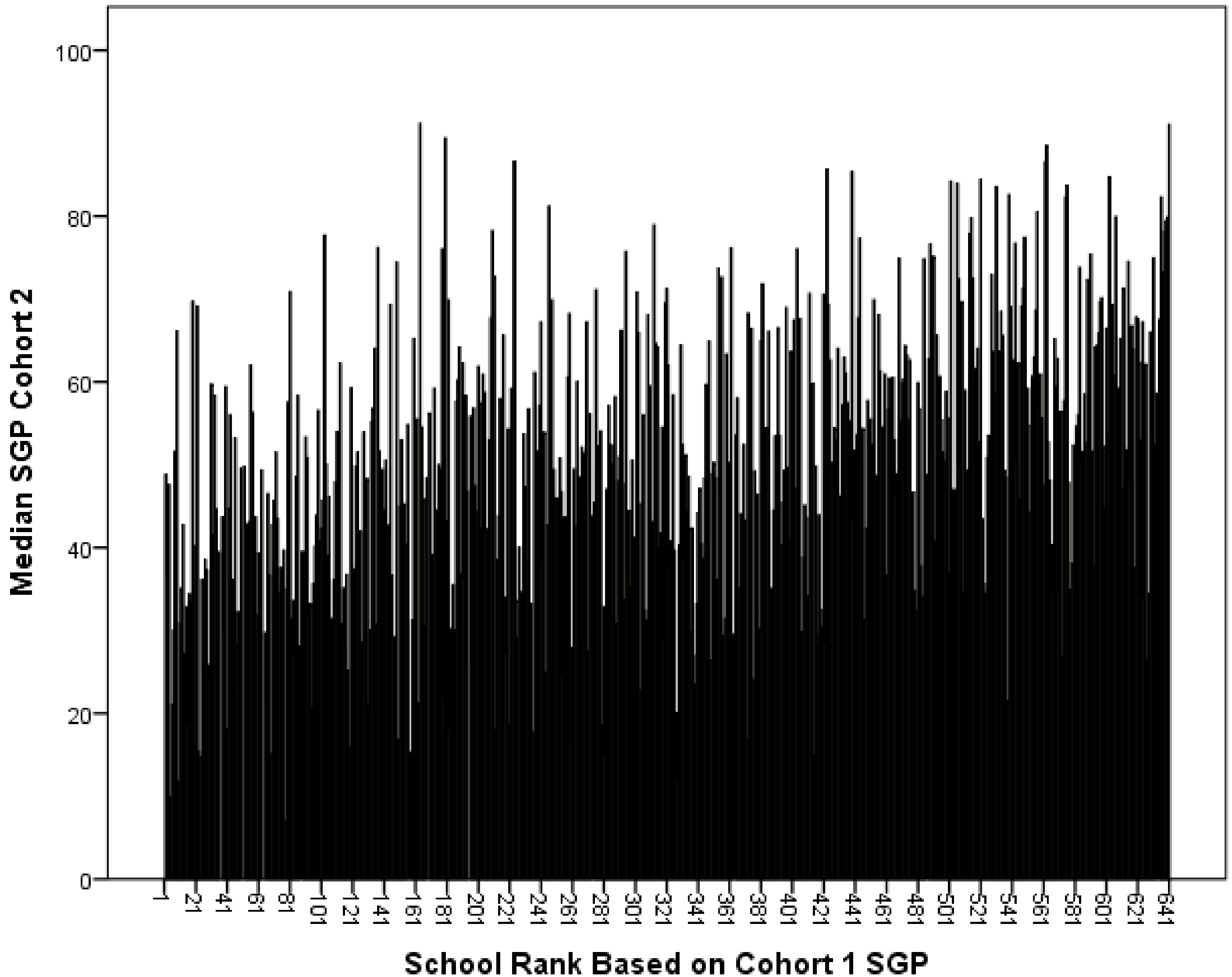
- Estimates of school effects across models sometimes very consistent, but other times very discrepant:
  - Most transition matrix models moderately to highly correlated with each other
  - SGPs almost perfectly correlated with conditional regression
  - Low to moderate correlation of SGPs with HLM growth
  - Low correlation of status models with HLM Growth
- Substantial cohort instability in the first state studied (Oregon)
- Several examples follow

Student Growth Percentiles (SGP)

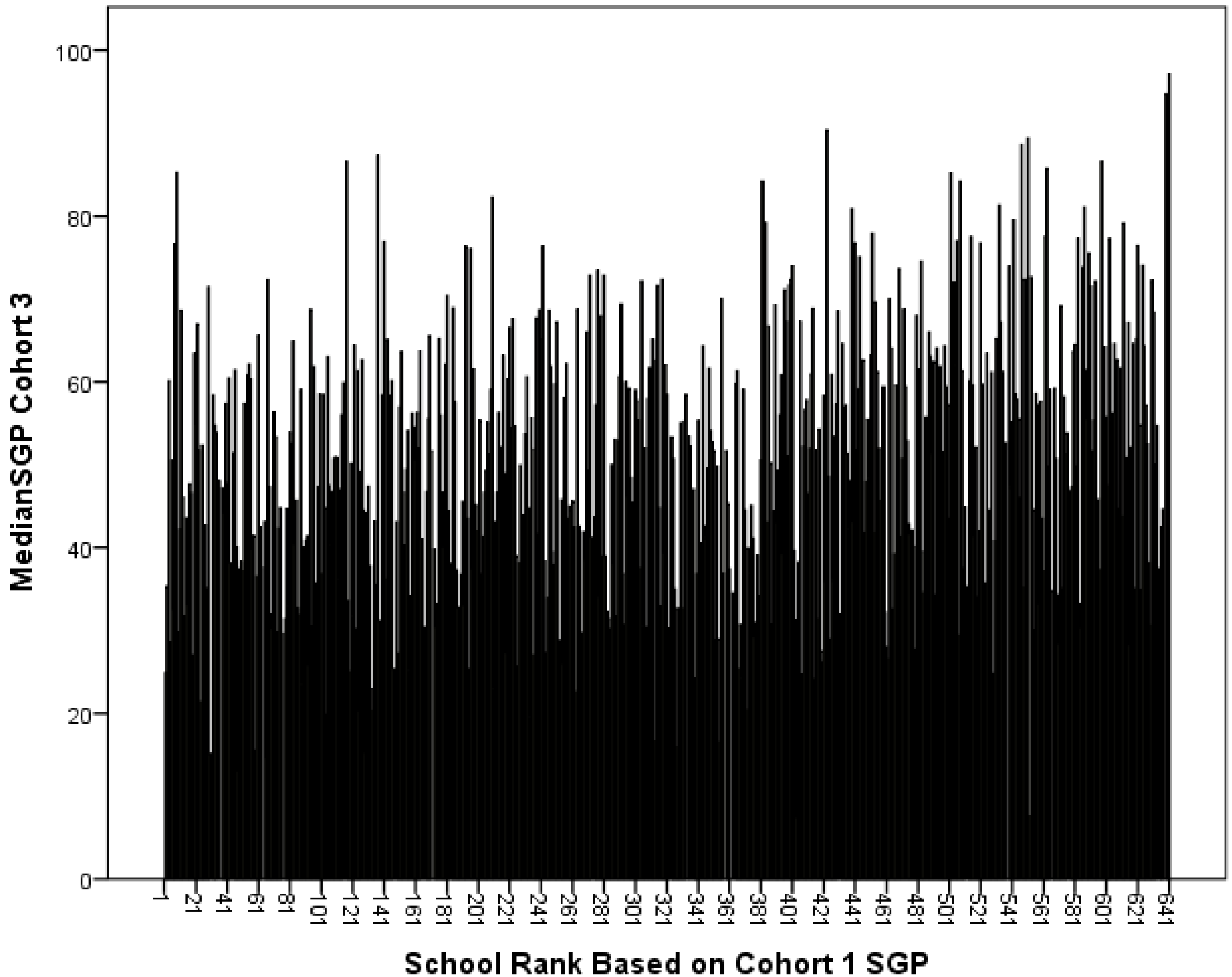
- Described as a Relative Growth Model
  - Current year performance conditioned on prior year(s) of performance using quantile regression
  - Relative rank in a distribution of those who had similar scores in previous years
- Oregon sample composed of all those who had a math or reading-language score in 2011 and at least one prior year score in years 2008-2010
- Currently popular approach in state accountability models used in dozens of states
- Result illustrated here is cohort instability using SGPs

Cohort Differences in SGP Models





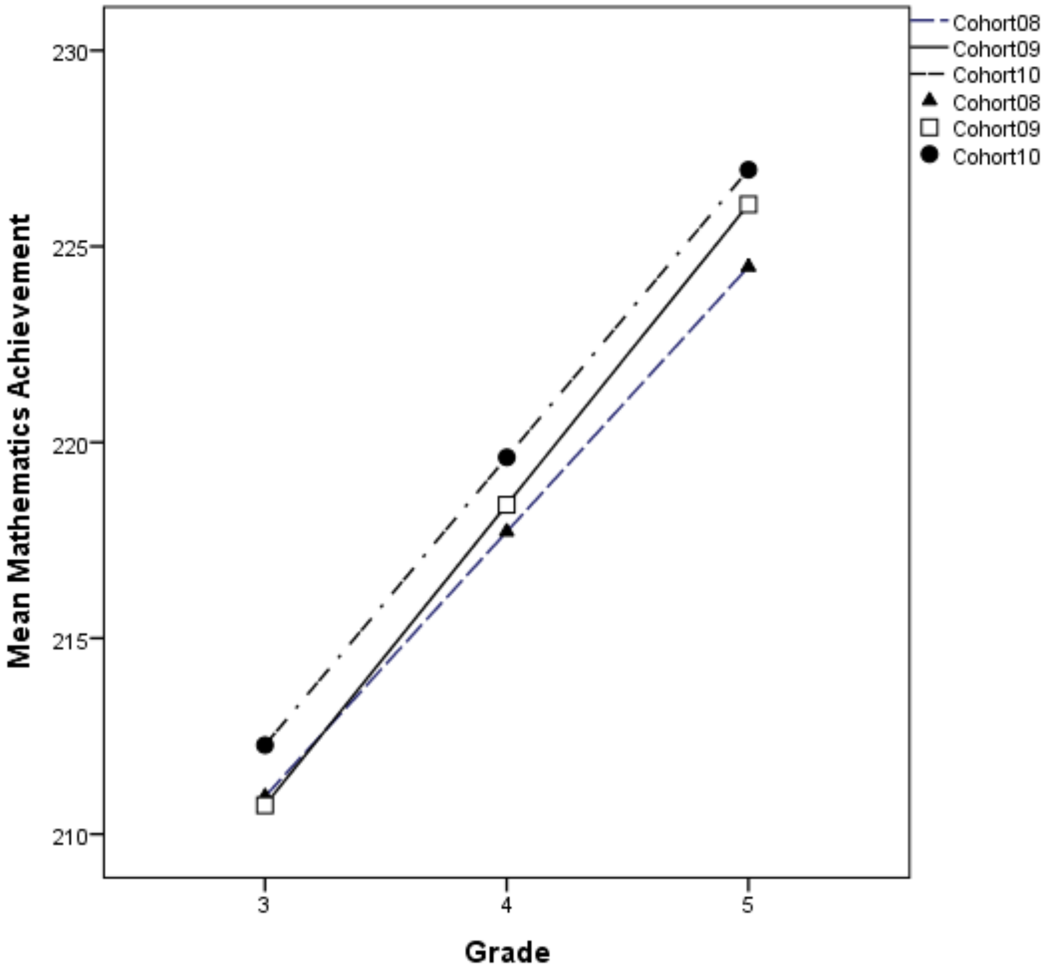
Median SGP Cohort 2
100
80
60
40
20
0
1
21
41
61
81
101
121
141
161
181
201
221
241
261
281
301
321
341
361
381
401
421
441
461
481
501
521
541
561
581
601
621
641
School Rank Based on Cohort 1 SGP


MedianSGP Cohort 3
School Rank Based on Cohort 1 SGP

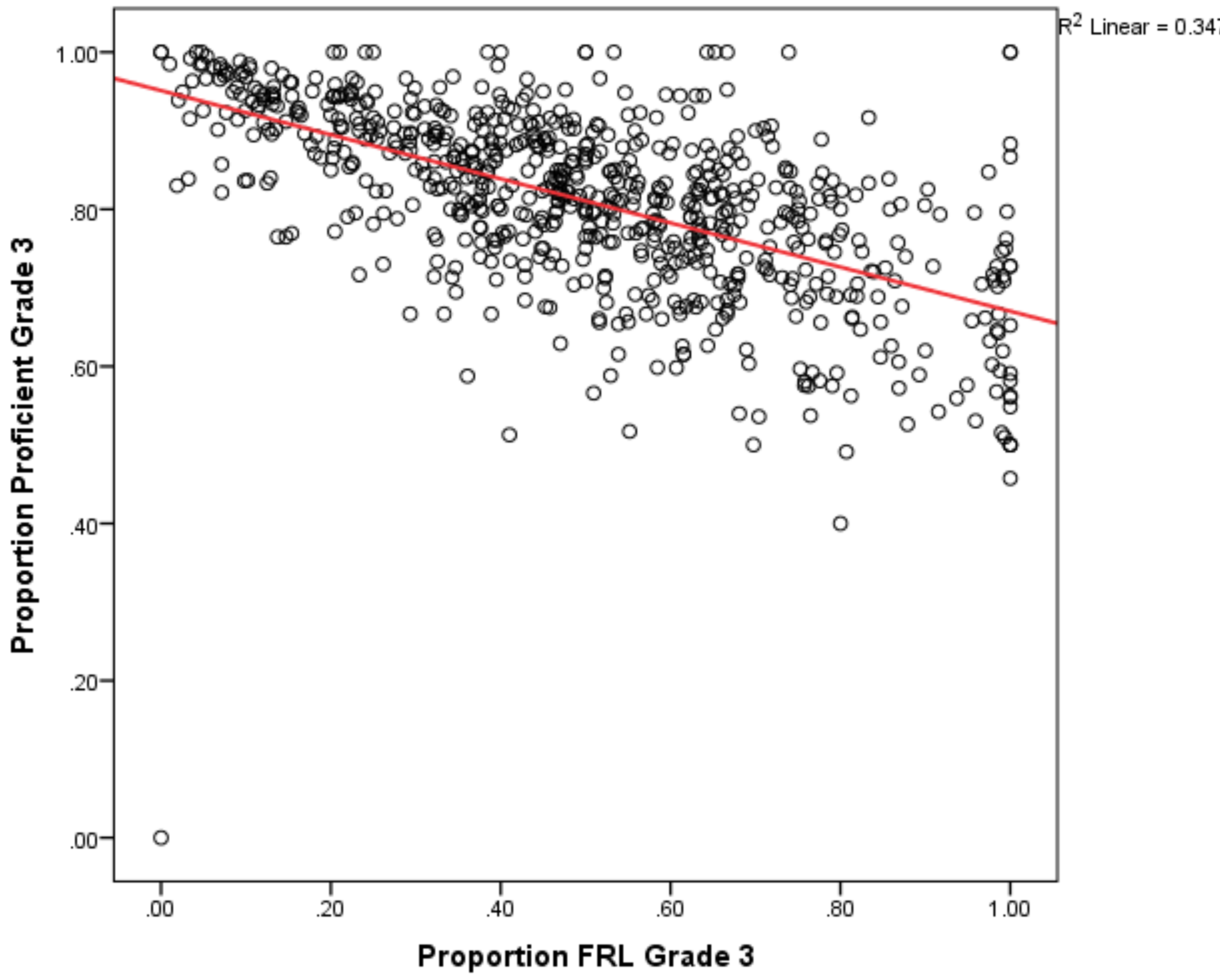
Hierarchical Linear Models

- Another alternative representation of student growth rests on the statistical modeling of change over time
- These models are absolute growth models in that they relate change to a time function and maintain the metric of the score scale
- Therefore a vertically linked score scale is necessary
- HLM models produce two primary outcomes, intercept (very similar to other status measures like school mean or PP) and growth estimate (slope)
- HLM results differ substantially from some other models especially status models (e.g., percent proficient)
- Illustration of cohort instability with HLM follows

Cohort Differences in HLM Growth Models



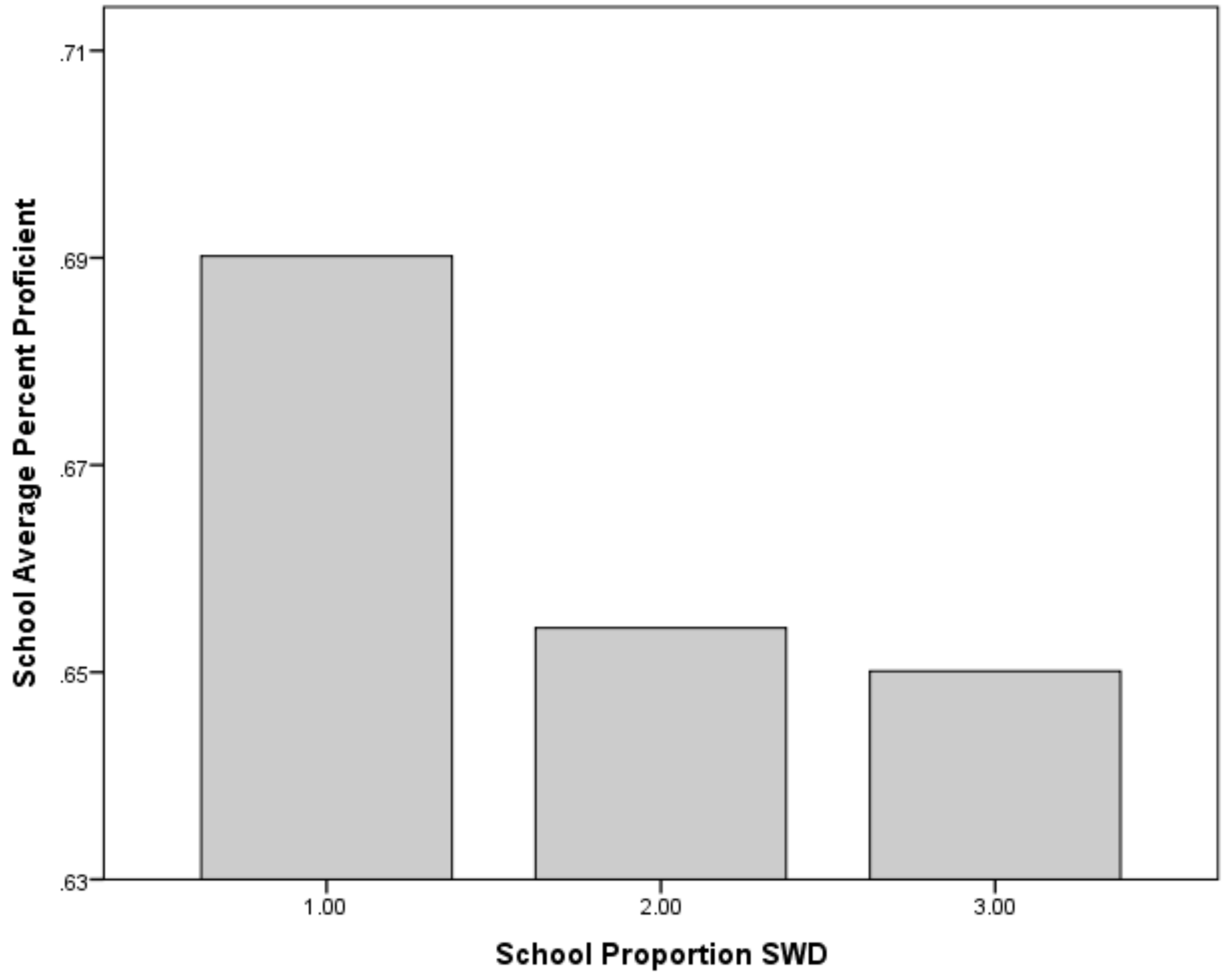
Covariate Relations with School Estimates



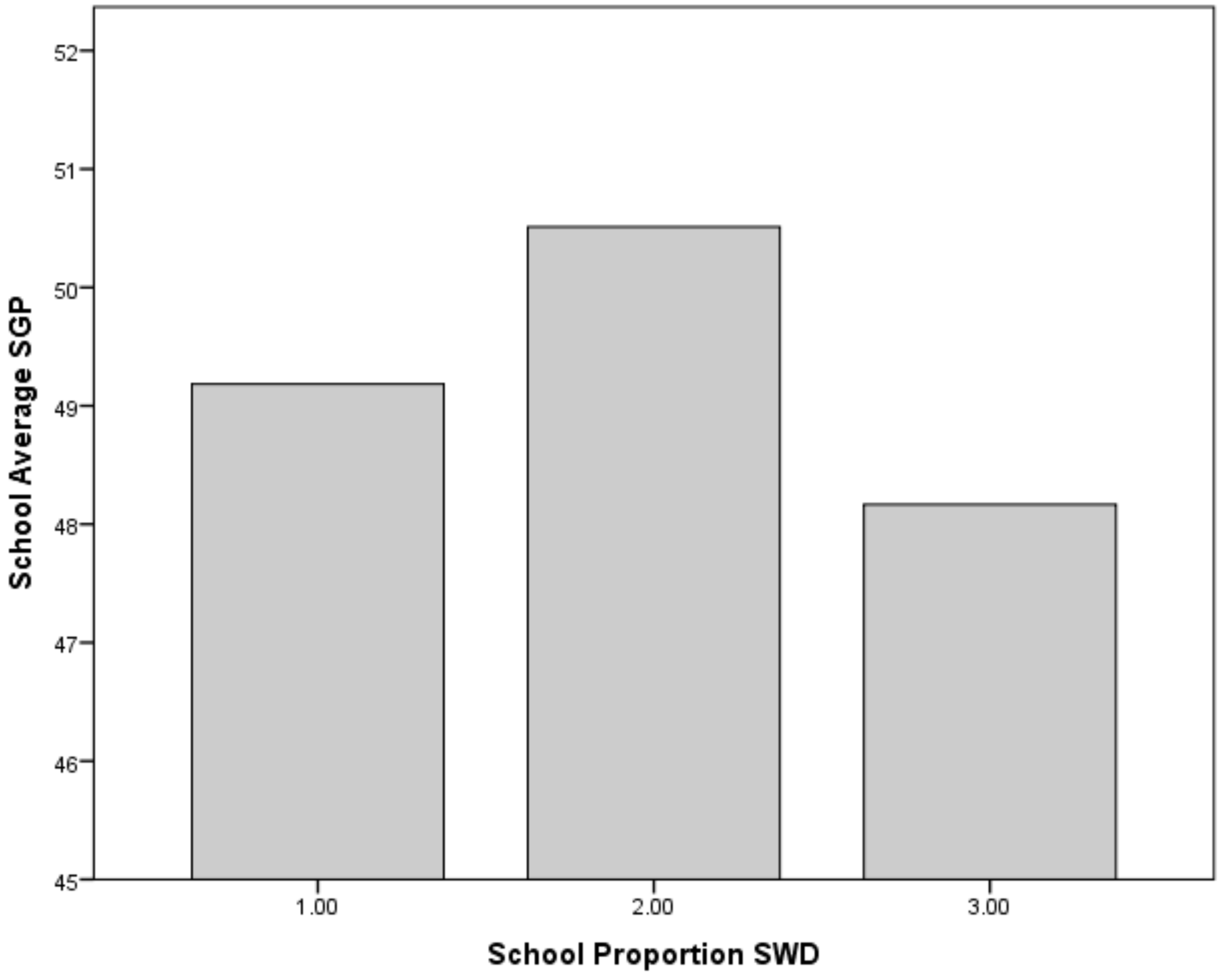
Relations of Model Estimates to School Proportion SWD

- School proportion SWD very positively skewed; variable was categorized for comparisons: Group 1, schools with 10% SWD or less; Group 2, 11-14% SWD; and Group 3: more than 14% SWD
- Significant differences by School SWD group for PP and HLM intercept; not statistically significant for SGP, HLM Slope

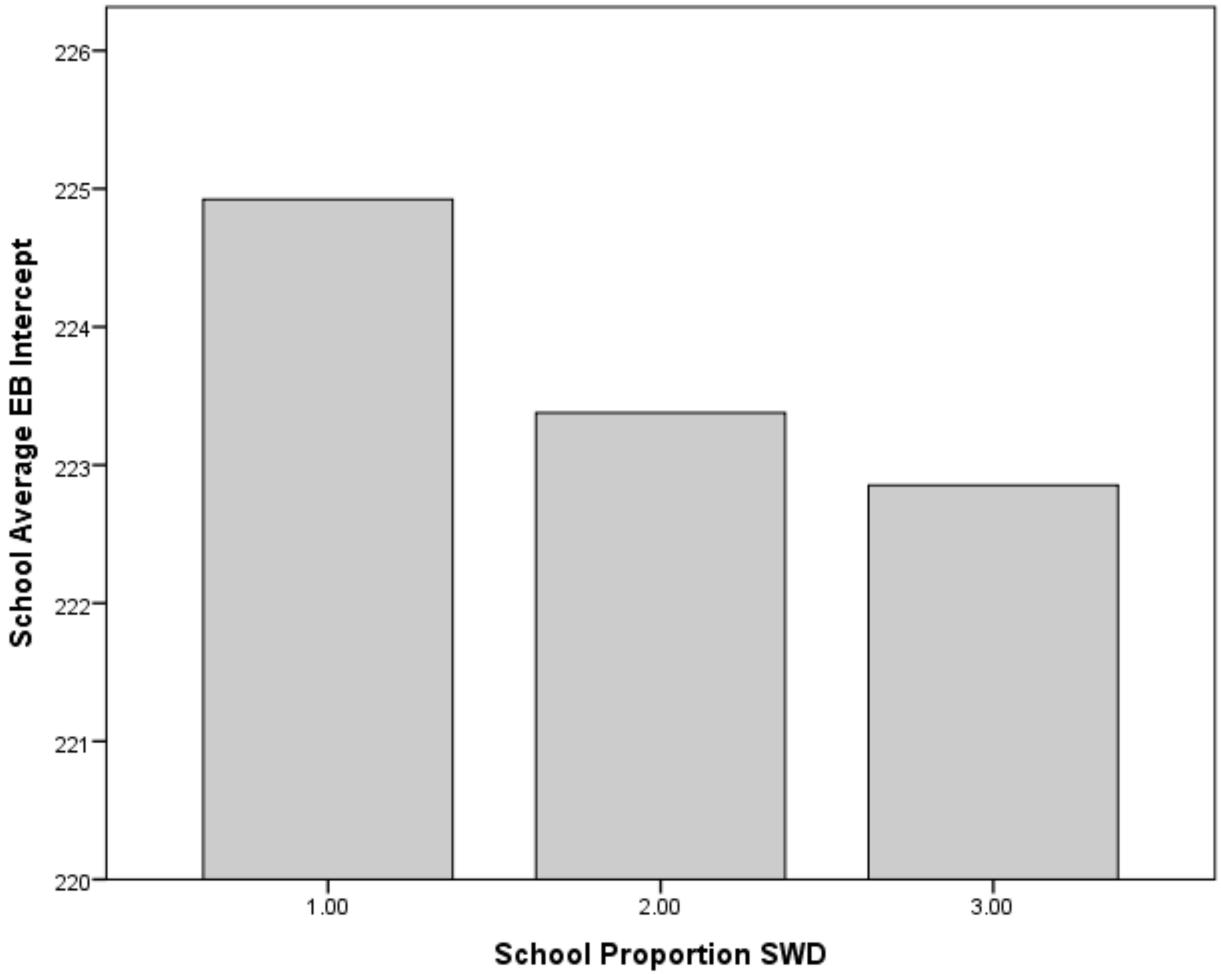
Relation of School Percent Proficient with School Proportion SWD (p = .018)



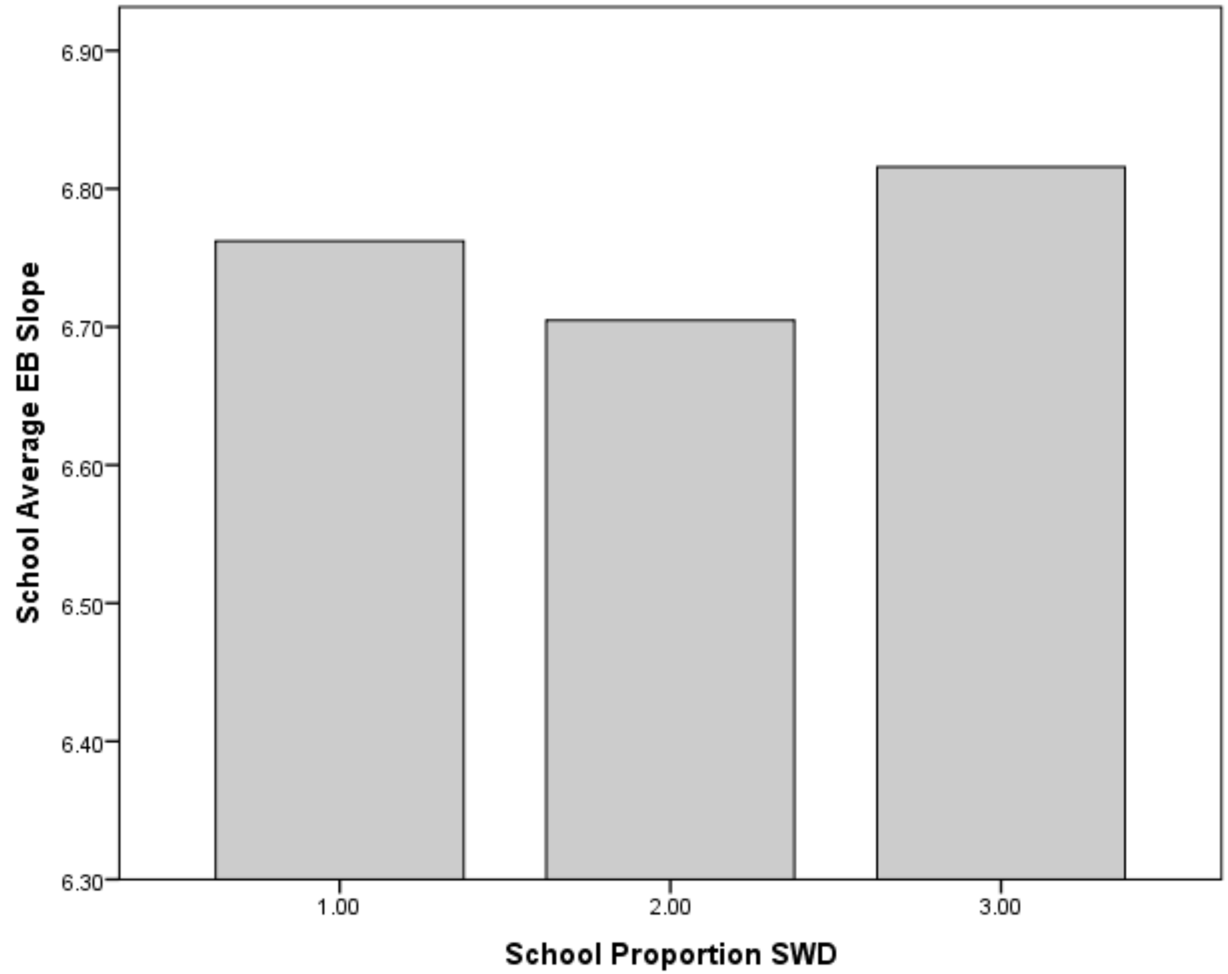
Relation of School SGP with School Proportion SWD (ns, p = .654)



Relation of HLM EB Intercept with School Proportion SWD ($p < .001$)



Relation of HLM EB Slope with School Proportion SWD (ns, p = .796)



Q and A

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