SPECIAL EDUCATION MATHEMATICS GROWTH:

Contrasting Stable and Variable Identification of Student Disability Status

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

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Moving to Growth as an Accountability Metric

- With concerns about NCLB "status" model in terms of fairness and validity—move to examine progress over time for individuals
- What is "natural developmental progress" in specific achievement areas for students with disabilities (SWD)?
  - Typical growth
  - Achievement gaps
- New questions, same issues in assessing the SWD subgroup…

“Fuzzy Data” for the SWD Subgroup

- Changing rate of participation in recent years and multiple test options (Chudowsky, Chudowsky, & Kober, 2009)

- Unstable membership in SWD group (Ysseldyke & Bielinski, 2001)
  - 20% entrances and exits per year
  - Achievement likely to play a role in entrance and exit decisions
  - Distorts achievement gap estimates

Accountability and Growth Modeling SWD Identification Methods Differ

- Cross sectional-NCLB
  - **Current Year**: Annual determination, by student special education status for year in question
- Longitudinal-Growth modeling
  - **Wave 1**: Group membership determined at initial data collection time point
- Problem: Age at identification related to exceptionality
  - Early identification for severe disabilities
  - Speech/language impairment early id and early exit (50% exited in SEELS, Marder, 2009)
  - LD id often in third grade or later due to identification criteria

SWD Subgroup Identification in Previous Achievement Growth Research

- Wei, Lenz, & Blackorby (2012)
  - SWD category determined at study entry-entered at ages 7 to 15
  - Math growth
- Shin, Davison, Long, Chan, & Heistad (2013)
  - SWD as time varying covariate
  - Math and reading growth
- Judge & Watson (2011)
  - LD only, explicitly examined when identified, early (K/1),emerging (2/3), late emerging (4/5)
  - Math growth
- Puranik, Petscher, Al Otaiba, Catts, & Lonigan (2008)
  - Speech/language impairment, examined “resolved” versus “persistent”
  - Oral reading fluency growth

Current Study: Four Options for Subgroup Membership

- Cross sectional
  - **Current Year**: As in NCLB, annual determination, by student special education status for year in question

- Longitudinal
  - **Wave 1**: Typical of longitudinal studies, SWD or non-SWD at initial data collection time point
  - **Ever in Special Education**: Student presence in special education at any time during grades 3-7
  - **Always in Special Education**: Student in special education for grades 3-7

Research Questions

- Does the characterization of the mathematics achievement gap change when the method for identifying the SWD subgroup varies?
  - Cross sectional (Current year), Wave 1, Ever, or Always
- Does the characterization of mathematics achievement growth change when the method for identifying the SWD subgroup varies?

  Wave 1, Ever, or Always
- Descriptive and HLM approaches to characterizing growth

Analytic Sample

- Original cohort sample, grades 3-8, 2001-2006, N = 103,123
- Exclusions (not mutually exclusive)
  - All grade 8 data due to new test edition
  - Off sequence cases, primarily retention (N =8,315)
  - Missing data on ethnicity or ethnicity = “other” (N = 48), sex (N = 11), parental education (N = 1,206), or exceptionality (N = 314)
  - Exceptionalities w/ N < 100 (Deaf-Blind, Multihandicapped, Moderate and Severe Intellectual Disability, Traumatic Brain Injury, Visual Impairment, Total N=411)
  - Never participated in large scale assessment (N = 1,729)
- Final analytic sample N = 92,045

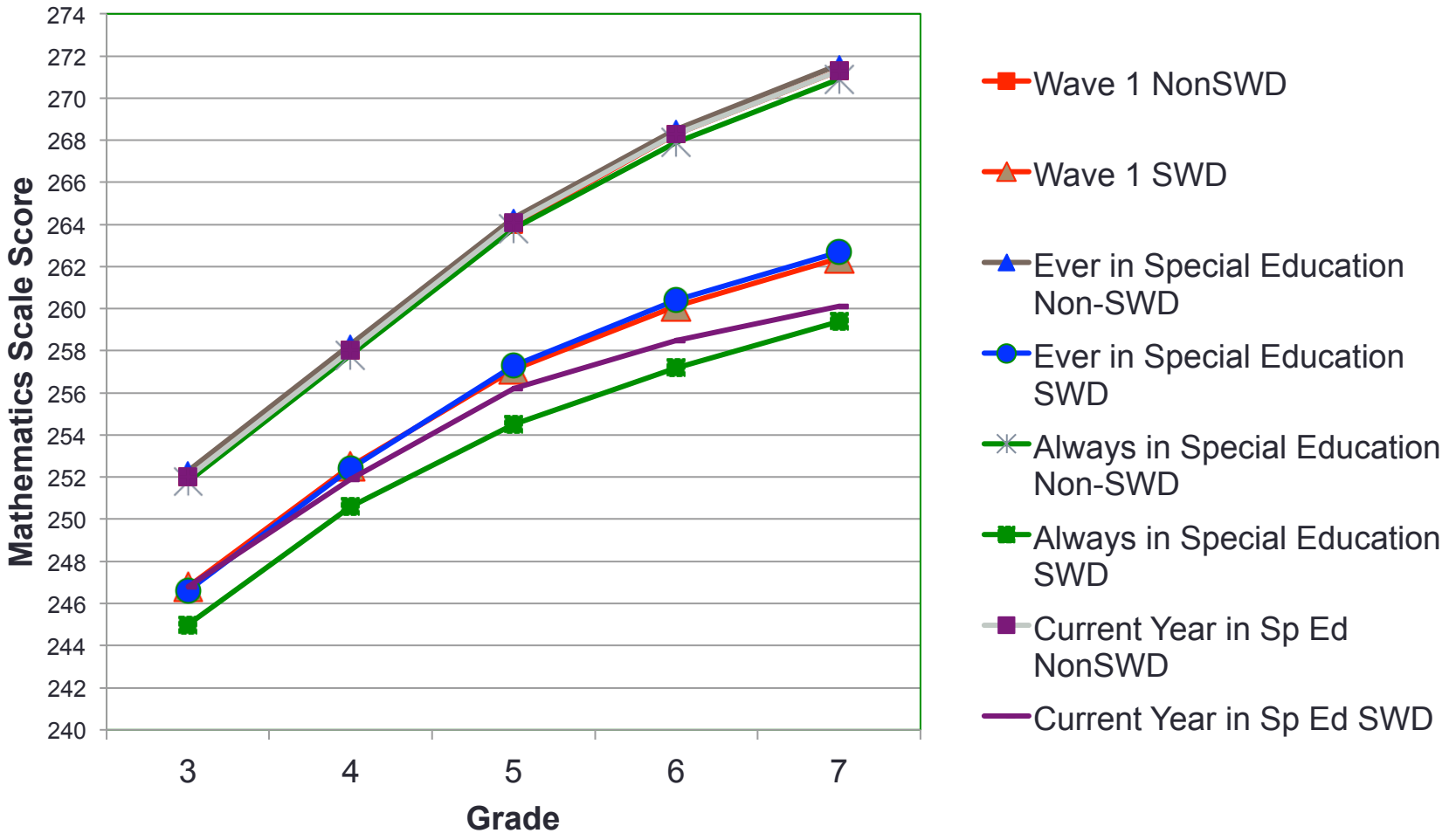
Demographics by SWD Identification Method

	Non-SWD, Wave 1	SWD, Wave 1	SWD, Ever in Spec Ed	SWD, Always in Spec Ed	SWD, Current Yr (Cross sec't)
% SWD	--	11.8	16.3	6.0	11.1-12.4
% Female	52.7	32.6	33.6	30.5	30.0-32.6
% Minority	38.5	38.8	40.3	44.2	37.7-54.9
% Free/Red Lunch	39.1	50.8	50.4	56.4	50.8-54.9
% Parent Ed < High School	9.2	18.9	18.1	22.7	18.9-21.0

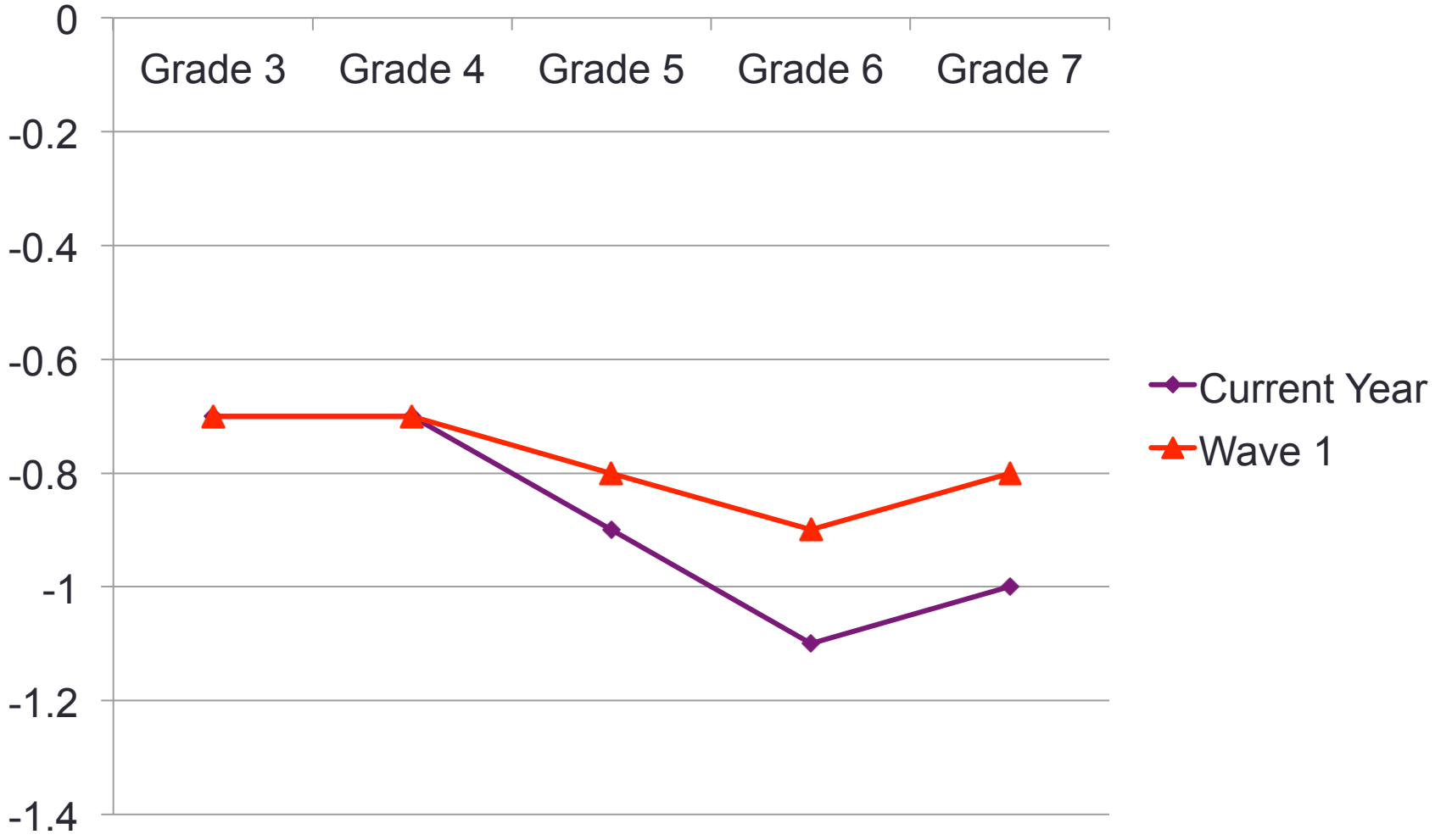
North Carolina End of Grade (EOG) Mathematics Test

- Multiple choice
- Based on NC Standard Course of Study in mathematics
  - Number sense
  - Spatial sense, measurement, and geometry
  - Patterns, relationships and functions
  - Data, probability, and statistics
- Administered annually, grades 3-8
- Developmental scale

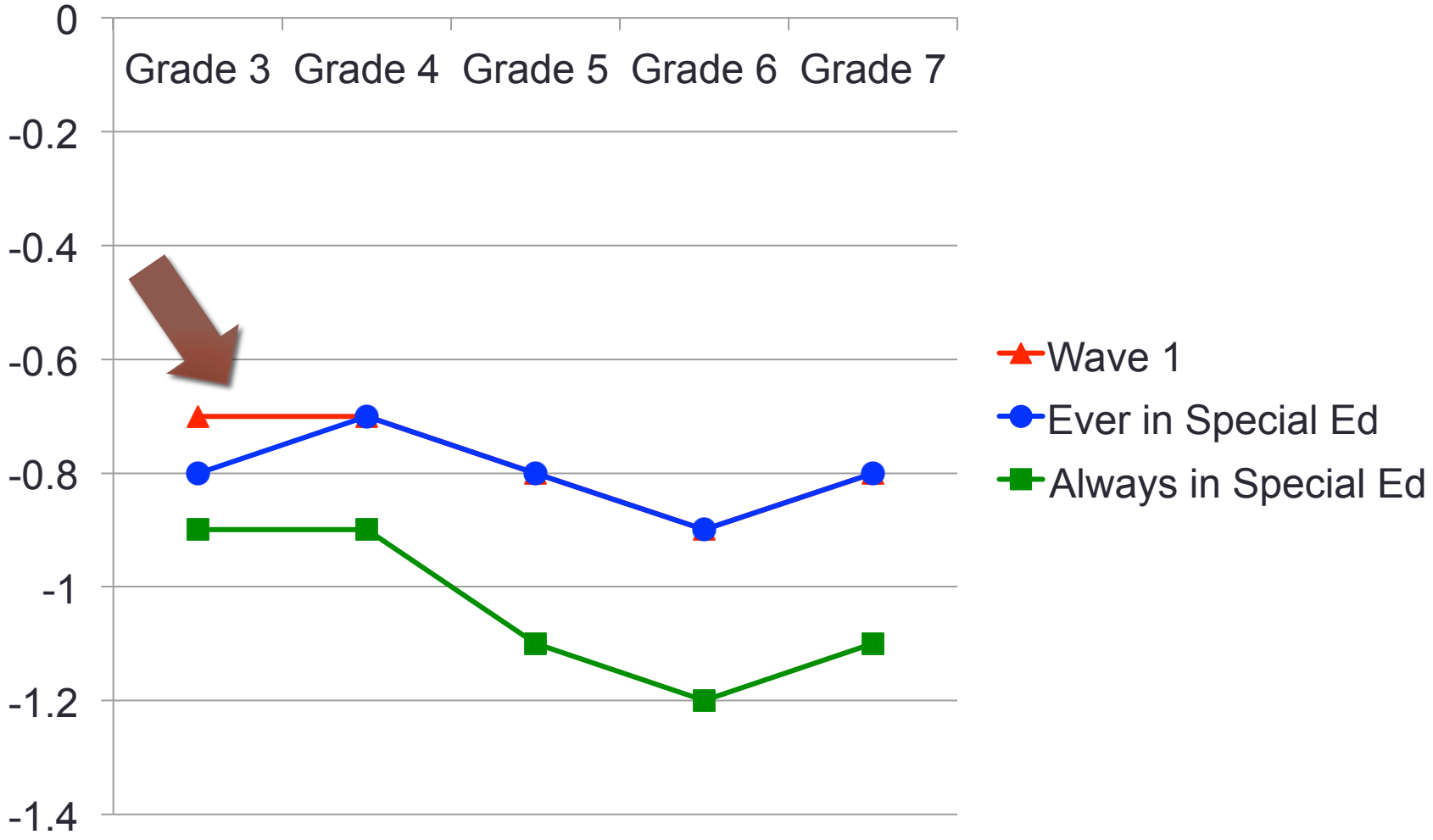
Observed Means by SWD Identification Method



Special Education Achievement Gaps Cross Sectional and Longitudinal



Longitudinal Mathematics Achievement Gaps by SWD Membership Criterion

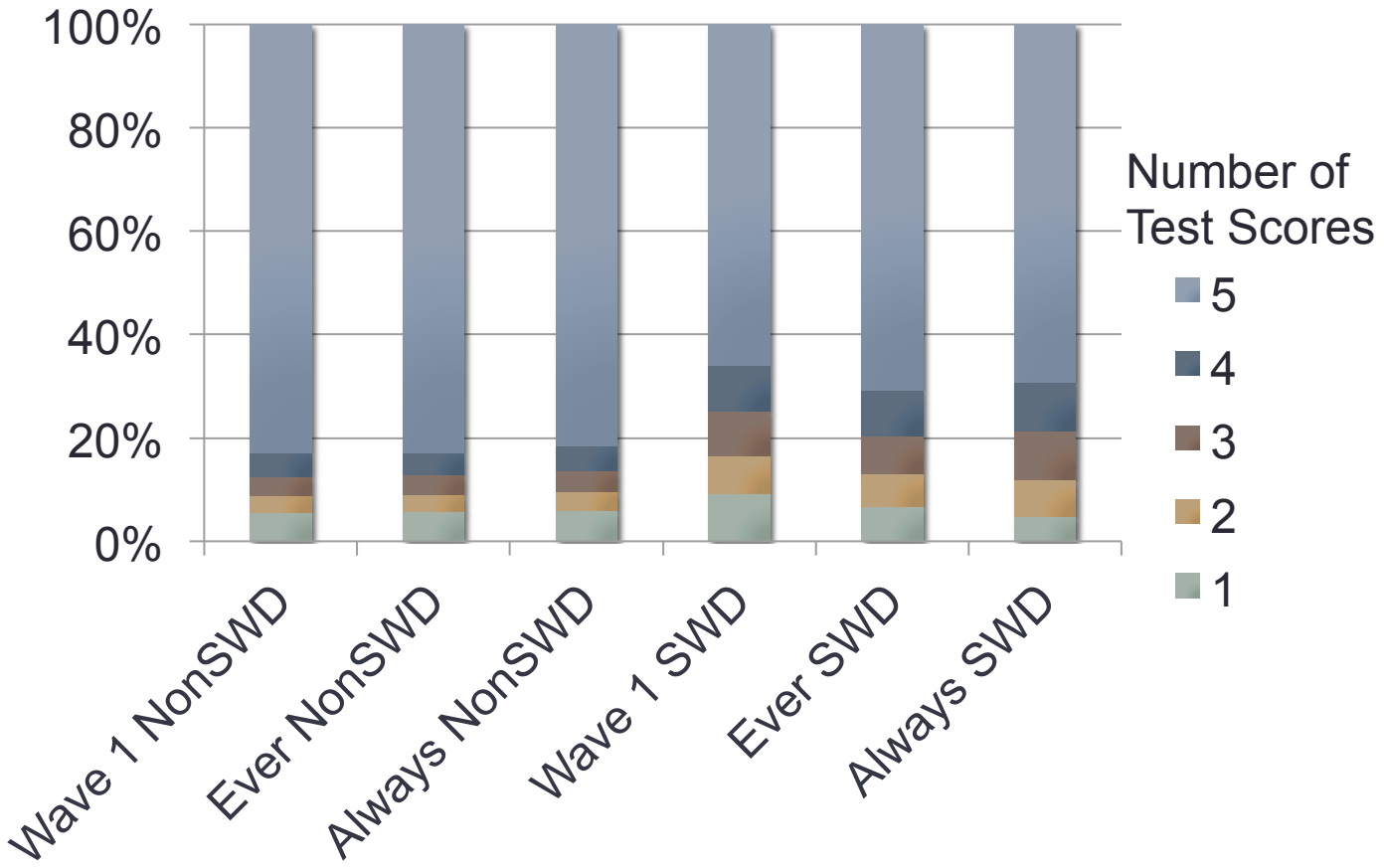


HLM Models

- Grades 3-7 math within test edition
- Two level models with measurement occasions at level 1 nested within students at level 2
- Unconditional model, followed by conditional models
- Used quadratic, with predictors for student demographic and background based on previous research with this cohort (Stevens & Schulte, in preparation)
- 3 separate conditional models varying SWD identification method
  - Special Education at Wave 1
  - Ever in Special Education
  - Always in Special Education

Measurement Occasions by Group

- Grades 3 to 7, “forward matched”
- All cases with one or more math scores retained



Two-Level HLM Results By Subgroup Definitions

	Special Education at Wave 1			Ever in Special Education, Grades 3 to 7			Always in Special Education Grades 3 to 7		
Predictor	Intercept	Linear	Quadratic	Intercept	Linear	Quadratic	Intercept	Linear	Quadratic
Grand Mean	253.86 (.04)	6.97 (.02)	-.52 (.01)	254.18 (.04)	6.96 (.02)	-.52 (.01)	253.55 (.04)	6.96 (.02)	-.53 (.01)
Special Education	-5.01 (.07)	-.64 (.05)	.01† (.01)	-5.30 (.06)	-.39 (.04)	.04 (.01)	-6.21 (.09)	-.92 (.06)	.02† (.02)
Limited English	-2.90 (.16)	-.11† (.11)	.03† (.03)	-2.72 (.16)	-.09† (.11)	.03† (.03)	-2.85 (.16)	-.11† (.11)	.03† (.03)
Parental Education	1.53 (.02)	.04 (.01)	.04 (.00)	1.50 (.02)	.04 (.01)	.03 (.00)	1.55 (.02)	.04 (.01)	.04 (.00)
Sex	-.42 (.04)	.02† (.03)	.04 (.01)	-.58 (.04)	.03† (.03)	.03 (.01)	-.30 (.04)	.02† (.03)	.04 (.01)
Free/ reduced Lunch	-1.43 (.05)	-.19 (.03)	-.01† (.01)	-1.39 (.05)	-.20 (.03)	-.01† (.01)	-1.46 (.05)	-.19 (.03)	-.02† (.01)
Asian	.47 (.17)	1.27 (.10)	-.07 (.03)	.33† (.17)	1.28 (.10)	-.07 (.03)	.61 (.17)	1.28 (.10)	-.07 (.03)
Black	-4.42 (.05)	.21 (.03)	-.11 (.01)	-4.40 (.05)	.22 (.03)	-.11 (.01)	-4.31 (.05)	.22 (.03)	-.11 (.01)
Hispanic	-.89 (.13)	.92 (.08)	-.15 (.02)	-1.02 (.12)	.93 (.08)	-.15 (.02)	-.79 (.13)	.93 (.08)	-.15 (.02)
American Indian	-1.99 (.18)	-1.47 (.11)	.29 (.03)	-1.90 (.17)	-1.46 (.12)	.29 (.03)	-1.97 (.18)	-1.47 (.12)	.29 (.03)

† Not statistically significant, $p > .05$

Note. Standard errors shown in parentheses

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Sex	**-.42** (.04)	.02† (.03)	.04 (.01)	**-.58** (.04)	.02† (.03)	.03 (.01)	**-.30** (.04)	.02† (.03)	.04 (.01)
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Research Question: Does the Achievement Gap Change with SWD Subgroup Definition?

- Cross sectional versus more inclusive longitudinal options produces larger gaps and more fan spread (widening of gap) across grades

- Special education treated as a stable subgroup, but only about one third of students who were in special education at some time in grades 3 to 8 were consistently in special education—these students show largest gap at grade 3 and fan spread across grades

- Regardless of way of comprising the SWD subgroup, a substantial and persistent achievement gap evident

Research Question: Does Characterization of Growth Change with SWD Subgroup Definition?

- All three id methods produced curvilinear growth across grade for nonSWD and SWD students
- Different SWD definition produced variation in intercepts and slope coefficients, and coefficients for some demographic characteristics
- Negative coefficient for slope for SWD subgroup indicates widening gap--controlling for demographics and missing data estimation may explain different results between observed and HLM-based portrayals of growth

Limitations

- Analytical sample differed from full sample
  - Loss of retained students and those never tested likely to over estimate achievement of both nonSWD and SWD students, but more impact on SWD subgroup
- Single state and cohort
- No direct statistical comparisons, as same students in each HLM model

Future Directions

- Explore subgroup definitions that are better suited to accountability purposes (e.g., progressively inclusive across grades SWD definition)
- Replicate findings with other states' achievement data
- Complete analyses with reading achievement—gap are likely to more pronounced

Conclusion

- Although growth models offer promise for more valid inferences about schools' effectiveness, SWD subgroup continues to present dilemmas in terms of accurate characterizations

- The combination of
  (a) changing membership across grades
  (b) performance on outcome variable related to determination of group membership, and
  (c) smaller subgroup size

presents one of the greatest challenges to SWD growth models, and solution may require nuanced interpretations, or changes in way students placed into subgroup