Innovations in Identifying Learning Disabilities Using Responsiveness-To-Instruction

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Three Presentations

- Dynamic Assessment for Fast Tracking First Graders into Appropriate Instructional Tiers in Reading
  - Doug Fuchs
- The Course of Reading Disability in First Grade: Latent Class Trajectories and Early Predictors
  - Don Compton
- The Course of Math Disability in First Grade: Latent Class Trajectories and Early Predictors
  - Lynn Fuchs

Dynamic Assessment for Fast Tracking First Graders into Appropriate Instructional Tiers

Doug Fuchs, Lynn Fuchs, and Don Compton

Why DA?

- With RTI, Tier 1 NRs are “at-risk” and enter Tier 2 tutoring as a diagnostic trial.
  - If responsive, we assume prevention has been accomplished.
  - If not responsive, we assume the student requires more intensive intervention.
- Problems:
  - Some who enter Tier 2 tutoring respond quickly. The costly Tier 2 tutoring was not needed.
  - For chronic NRs, valuable time is lost in Tier 2 (10-30 weeks, depending on RTI model), before more appropriately intensive intervention can be delivered.

Why DA?

Can DA, in combination with other measures, accurately and efficiently identify:

* False positives who don't require Tier 2 tutoring (thereby saving schools valuable resources)?

* Chronic NRs for whom Tier 2 will be ineffective and special ed is necessary?

Our DA

- One 15-30 minute session
- Scripted, standard administration
- Designed to teach three decoding skills (taught as linguistic word families):
  - CVC, CVC*e*, CVC(C)*ing*.
- Uses pseudowords

Our DA

- For each decoding skill, 5 levels of increasingly explicit, scaffolded instruction (aka: “graduated prompts”).
- After each instructional level, 6 nonsense words are presented (not used for instruction, but paralleling instructional items).
  - If 5+ words are read correctly, the skill is deemed mastered, and the child progresses to the next skill.
  - If < 5 words are read correctly, the student moves to the next, more explicit instructional level for the same skill.
- If the student fails to achieve mastery across the 5 instructional levels on a given skill, the DA session is terminated.
- Score: Number of instructional levels necessary to master the 3 decoding skills (15 = student requiring all 5 levels on each of the 3 skills; 3 = student requiring only 1 level per skill).

Scaffolding Levels for CVC

1. Read sample words to the child.

2. Teach onset (e.g., examiner models differentiating words that start with /b/ vs. words that start with /z/).

3. Teach rime (e.g., examiner models differentiating words that rime with /od/ vs. words that rime with /om/).

4. Teach onset-rime blending (e.g., “This is the letter “b”. These two letters say /om/. Together, the sounds say /b/ /om/ /bom/”).

5. Teach onset-rime blending II (e.g., same as #4 except child then teaches tester how to read /bom/; then, plays game “Guess My Word” where tester says words that child identifies; last, child plays tester’s role in “Guess My Word”).

Two Studies
Research Questions

1. What is the concurrent validity of DA with conventional measures of reading skill?

2. What is its value-added when combined with appropriate measures to predict responsiveness to reading instruction?

Study 1: Mid-Year + 5 Weeks First Grade

- Participants were 105 1st-grade students.
- In January, children were given WRMT Word ID, WRMT WA, and DA.
- Each week, for 5 weeks, Word Identification Fluency (WIF) was collected to estimate initial intercept and slope.
- At Week 6, children were administered Word ID, WA, and Passage Reading Fluency.

Study 1 Results: Concurrent Validity in January

- Correlations between DA (3 to 15-point score) with:
  - WRMT Word ID: ……*r* = - .65
  - WRMT Word Attack: ……..*r* = - .78

- *Adequate concurrent validity*

Study 1 Results: Predictive Validity across 5 Weeks

- DA, WIF intercept, and WIF slope were statistically significant predictors of Week 6 performance, explaining:
  - 73% of the variance in WRMT Word ID
  - 66% of the variance in WRMT WA
  - 76% of the variance in Passage Reading Fluency

Study 1 Results: Predictive Validity

- After controlling for WIF intercept and slope, DA explained:
  - 12% of the unique variance in WRMT Word ID
  - 20% of the unique variance in WRMT WA
  - 2% of the unique variance in Passage Reading Fluency
- *Potential of DA as a short-term predictor of reading development*

Study 2: Recruitment

- 4 schools in Metro-Nashville (2 high poverty, 2 middle class)
- 22 K and 1st grade teachers
- 216 student screened to ensure at least partial success on DA
- 133 (28/111 K, all 105 1st graders) continued in the study

Study 2: Measures

- Following pretest measures were given in random order by well-trained examiners in 1 session:
  - RLN, Segmentation, WRMT: WA, WRAT-Reading, WRAT-Arithmetic, WASI (Block Design and Matrix Reasoning), CBM-Reading
- DA given in second session

Study 2: Procedures

- After 11 wks of class instruction children posttested on same pretest measures, except that we:
  - Eliminated WRAT-Arithmetic
  - Added WASI Vocabulary and Similarities
  - Added oral reading fluency and WIAT-Spelling
- 11 CBM data points using WIF

Study 2 Findings: Concurrent Validity

DA correlations with pretest measures:

WRMT-R WA:	r = -.63
WRAT-Reading:	r = -.64
WRAT-Arithmetic:	r = -.46

Study 2 Findings: Concurrent Validity

DA correlations with 11-wk posttest measures:

WRMT-R WA:	r = -.70
WRAT-Reading:	r = -.65
WRAT-Arithmetic:	r = -.55

Study 2 Findings: Dominance Analysis

Amt of Variance Explained by DA on Posttest Composite Reading Variable (CBM Passage Reading, WRMT-WA, and WRAT-Reading), after Controlling for

- Pretest decoding inventory on same 3 skills: …….9%
- CBM intercept (WIF pretest score): ……..11%
- Short-term CBM (5-wk WIF) slope: ……..…. 30%
- All three variables: …….. 4%

Study 2 Findings: Dominance Analysis

- Variance accounted for after controlling for three competing variables:
  - DA: ……4%
  - Decoding inventory on same 3 skills: …….2%
  - CBM-Intercept (WIF pretest)……7%
  - CBM-Slope (WIF for 5 weeks): ……..1%

Conclusions: Concurrent Validity

- The concurrent validity of our DA in early reading across studies #1 and #2, and across pretests and posttests, suggests it “behaves” like relatively established reading measures

- Lower correlations with WRAT-Arithmetic in both studies suggest its modest construct validity

Conclusion: Predictive Validity

- Regression analyses in Study #1 and more stringent dominance analyses in Study #2 suggest DA can contribute uniquely to short-term predictions of reading performance….

- Even when controlling for a decoding inventory that addresses the same three skills in the DA

In Sum

- DA may be an important addition to a small battery of measures that help make the RTI process more efficient for schools and helpful to children at risk for reading failure.

Study 3 Features

Across Presentations 2 and 3

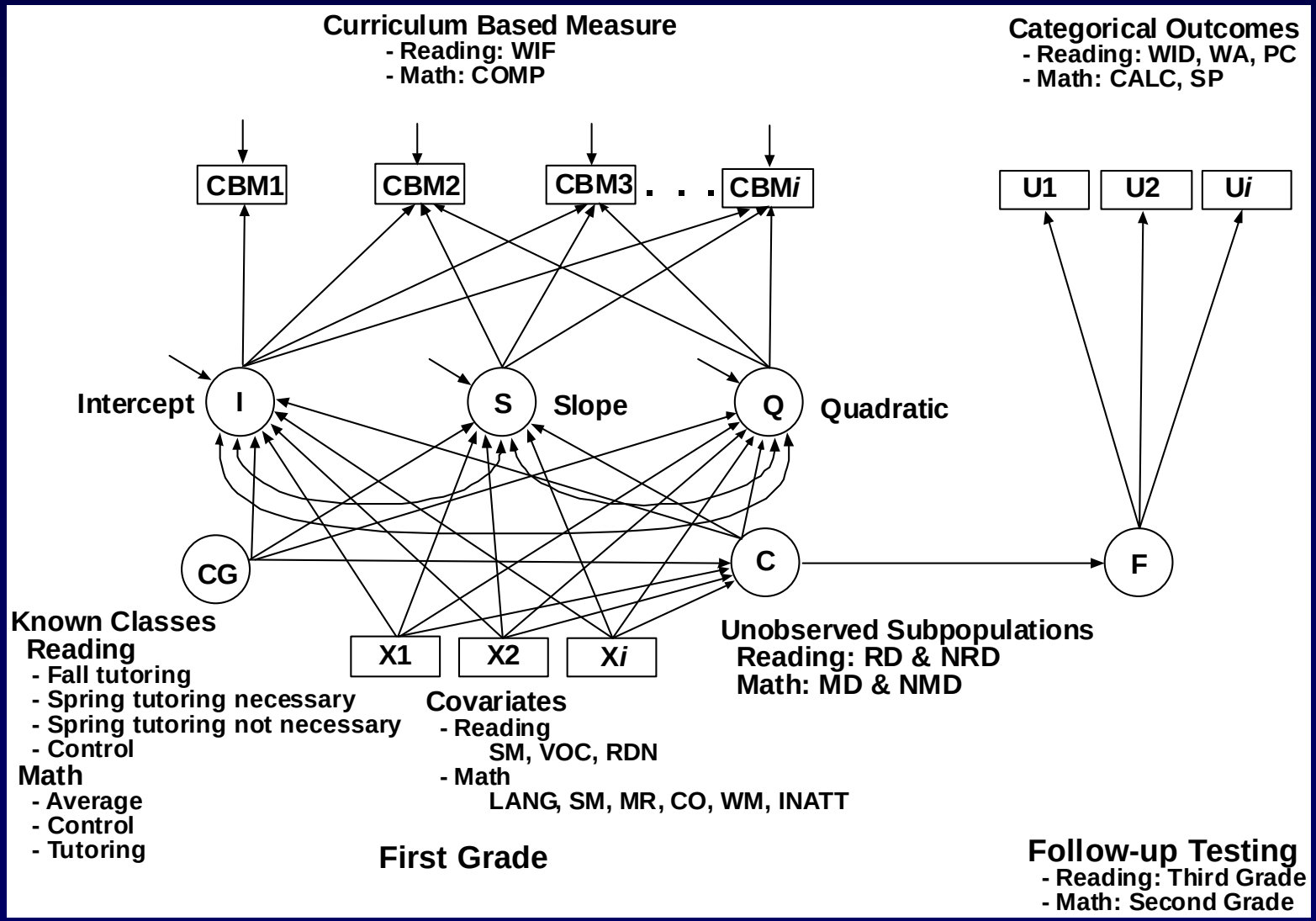
- The Course of Reading Disability in First Grade: Latent Class Trajectories and Early Predictors
  - Don Compton
- The Course of Math Disability in First Grade: Latent Class Trajectories and Early Predictors
  - Lynn Fuchs

Some Common Information

Questions

- Previous work: Longitudinal growth modeling across grades
- Given importance of achieving basic reading and math competence across 1st grade, little attention to describing trajectories of development within 1st grade.
- Purpose of Presentations 2 and 3 (reading and math)
  - Identify 1st-grade growth trajectories characteristic of later disability versus ND
  - Examine effects of 1st-grade tutoring on trajectories
  - Explore cognitive profiles associated with each latent class

General Model for Identifying Trajectory Classes



Analysis Plan

- Conventional growth modeling to evaluate appropriateness of the hypothesized quadratic model
- Multiple group growth mixture modeling with a distal latent factor (F, at end 3rd grade in reading; end 2nd grade in math) and beginning 1st-grade covariates to identify disability and nondisability populations within each known group.
  - Distal latent factor was regressed on the categorical latent variable (C), representing subpopulation CBM growth characteristics in 1st grade.
  - Subpopulation variable (C) was regressed on the known class variable (CG).
  - Growth parameters (I, S, Q) and C were regressed onto the time-invariant covariates.

Estimated Parameters of Interest

- Average latent class probabilities: likelihood each individual belongs to each class
- Class-specific profiles: likelihood each individual in the class scores above/below criterion for disability on distal latent class indicator
- Means/variances on
  - Growth parameters (I,S,Q)
  - Beginning 1st-grade performance
  - Cognitive predictors
  - End-study performance as function of known class and disability/nondisability trajectory class
  - Class-specific probabilities for categorical latent variable as function of the covariates

Data Analysis

- Growth model analyses with Mplus 4.0
- Model estimation used maximum likelihood estimator with robust standard errors
- CBM data centered on initial assessment
- Mplus missing data module (maximum likelihood missing at random estimation procedures)
- Estimated starting values derived from multiple group analysis of growth using only the CBM data
- Covariates centered on grand means

The Course of Reading Disability in First Grade: Latent Class Trajectories and Early Predictors

Don Compton, Lynn Fuchs, and Doug Fuchs

Reading Study Sample

- 42 1st-grade classes in 16 schools (8 Title)
- Six lowest readers from each class on WIF and RLN, with teacher corroboration (252 low-study-entry children)
- Beginning 1st grade, 6 children from each class rank ordered and, within class, split into 2 strata
- Within each stratum within each class, randomly assigned to 3 groups (n = 84 per condition)
  - No tutoring (n=55 [65.5%] complete data at end grade 3)
  - Fall 1st-grade tutoring (n=61 [72.6%] complete data at end grade 3)
  - Spring 1st-grade tutoring, but only with inadequate slope/final intercept for fall 1st grade (n=64 [76.2%] complete data at end grade 3)
- Three groups comparable demographically and on RLN, WIF, IQ, WRMT WID/WA, TOWRE SW/PD
- 18 weekly Word Identification Fluency measurements
- End of 3rd grade, disability: <85 on latent variable of word reading, nonsense word reading, comprehension

Reading Study Sample: January of Grade 1

- Four known classes
  - No tutoring
  - Fall tutoring
  - Spring tutoring-necessary (*n*=32 at end grade 3)
  - Spring tutoring-unnecessary (*n*=32 at end grade 3)
- Comparable on demographics and IQ
- On most reading variables, spring tutoring-necessary < spring tutoring unnecessary

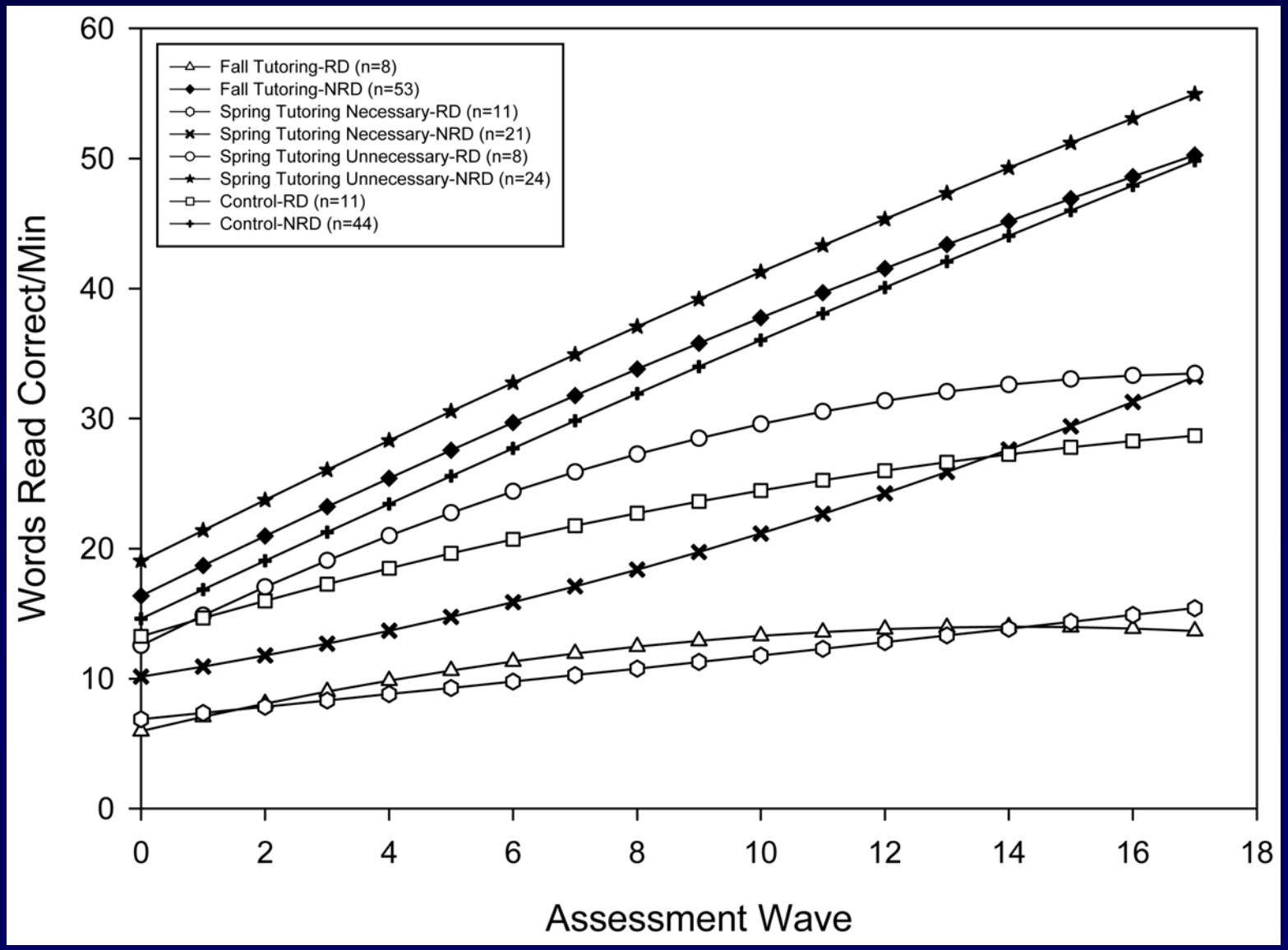
Tutoring

- 9 weeks in fall or spring
- Groups of 1-4, conducted by our master's students
- 45 min per session, outside classroom
- 66 sequentially ordered lessons
  - Word recognition
  - Phonemic awareness
  - Letter-sound association
  - Decoding
  - Echo reading, choral reading, speed game
- Audiotaped (24 sessions coded for fidelity: 98.7% middle tutoring; 96.6% end)

Results: Conventional Growth Modeling

- Word identification fluency (WIF)
- 18 weekly across fall and spring
- Quadratic model improved overall fit of model over linear model
- I: 14.20 words (SE=0.719; z = 19.74)
- S: 1.80 words per week (SE=0.138; z = 13.09)
- Q: -0.015 words^2 per week (SE=0.006; z = -2.31)

Results: Growth Mixture Modeling



Results: Growth Mixture Modeling

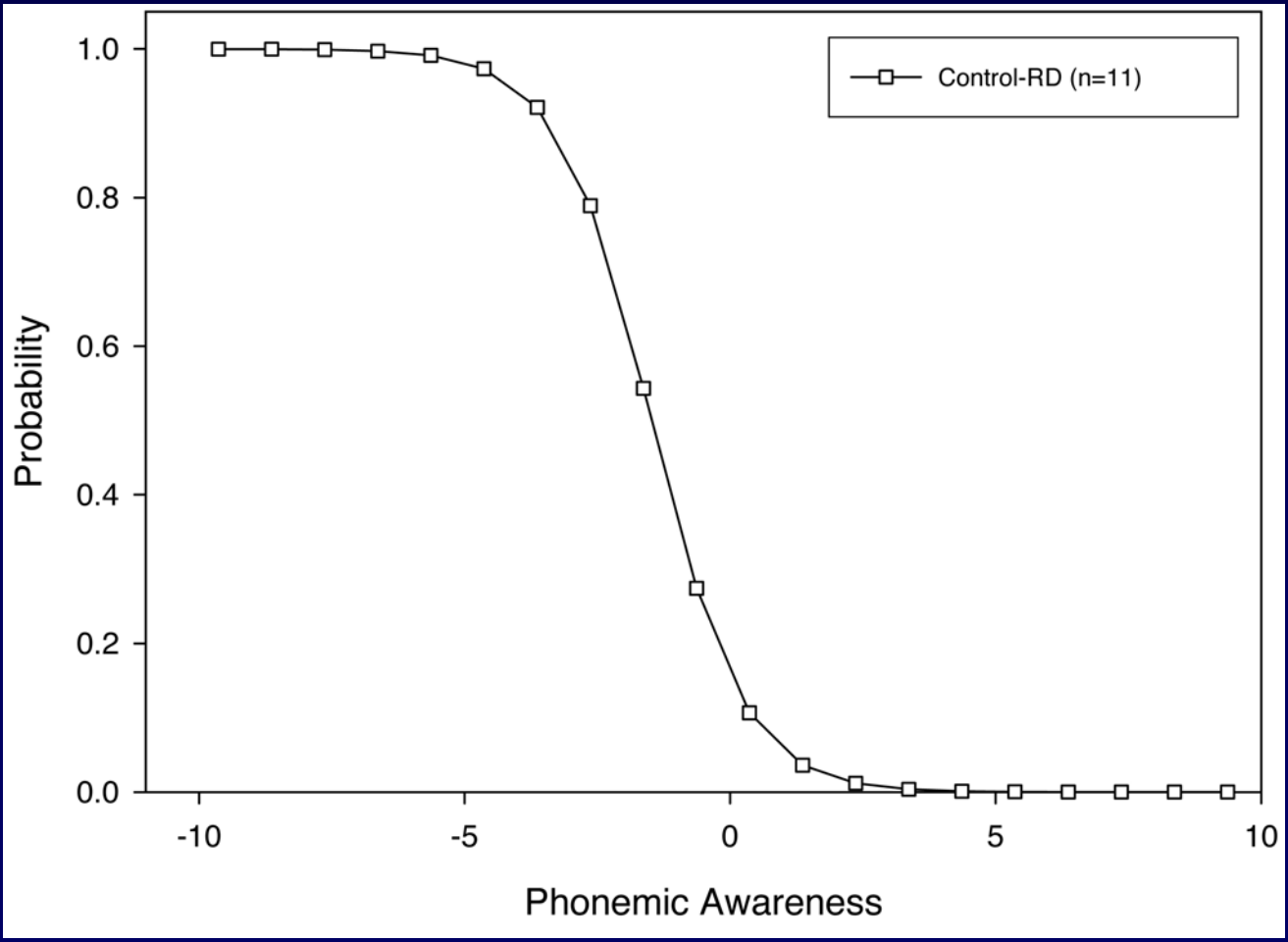
- For each trajectory class, intercept and slope was significantly greater than zero.
- Quadratic term significantly different from zero only for
  - Fall tutoring (z = -2.574)
  - Spring tutoring-necessary (z = 4.346)

Results: Growth Mixture Modeling
(across entire sample)

- Average latent class probability: Probability child is assigned to correct disability trajectory class within the known class: .912 to .995 (precise)

- Class-specific profiles on 3rd-grade latent class indicators of disability (WID, WA, PC): Probability child in that class would score > 85
  - WA: Across disability groups, poor precision.
  - WID and PC: More consistently distinguished RD from ND.
  - For spring tutoring-unnecessary RD group, class-specific probabilities indicate this class does not have a characteristically RD profile.
  - For control RD group, high class probability of scoring normal on WID, but low class probability of scoring normal on PC. So, poor reading comprehension is the defining characteristic of untreated at-risk students.

Estimated Multinomial Regression of Latent Class Variable on Covariates



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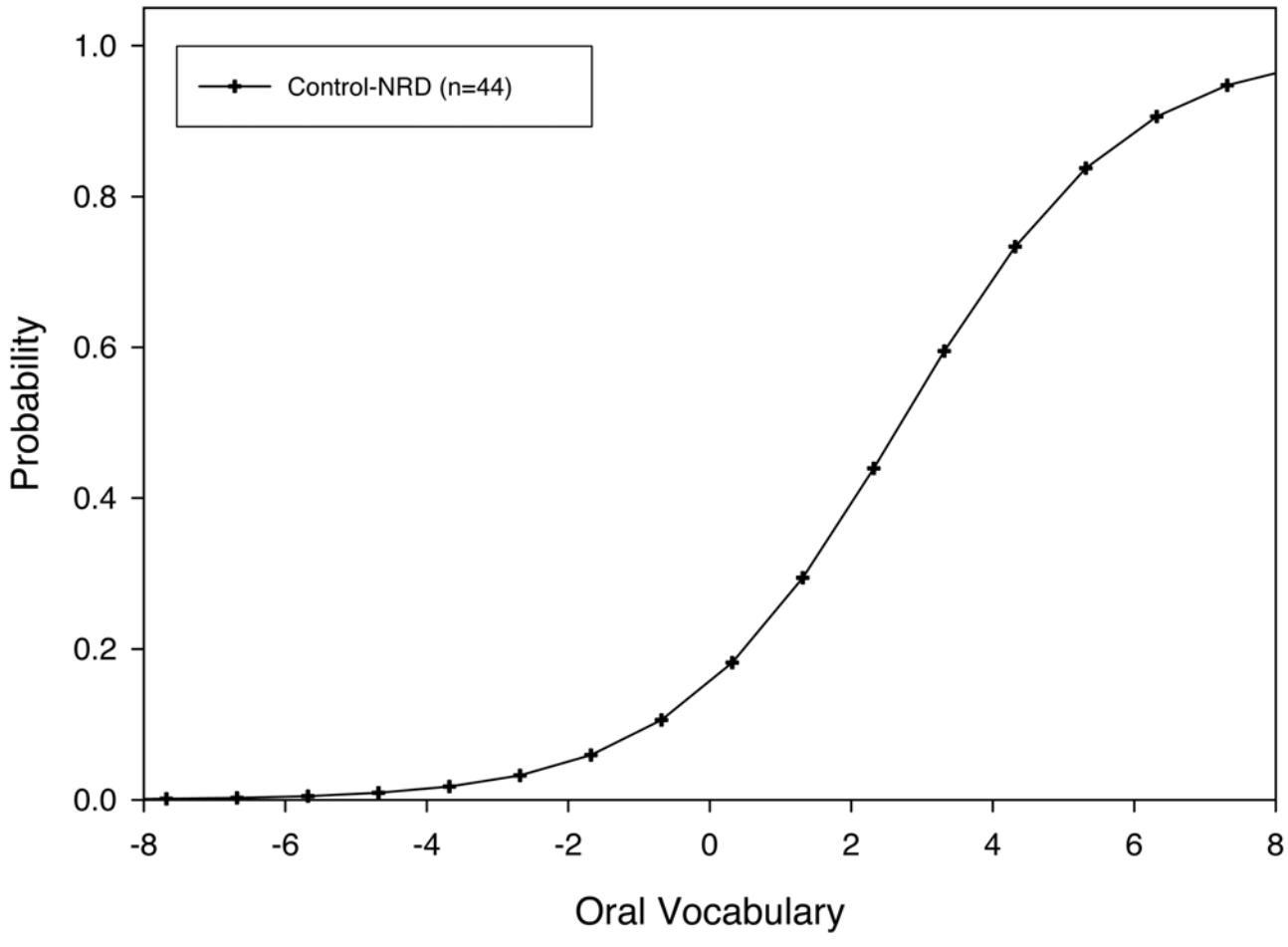


Plots represent estimated class-specific probability of class membership as function of one covariate, while keep other covariates constant

- Sound matching and vocabulary distinguished latent class membership, but only in control group.
- Control students with lower sound matching scores have great probability of being assigned to control RD class.
- Control students with higher vocabulary scores have great probability of being assigned to control ND class.

Conclusions

- First-grade trajectory classes associated with 3rd-grade disability status can be identified with high precision using WIF. So, WIF can be used for 1st-grade progress monitoring within RTI, as an indicator of long-term RD status.
- In control (untreated) group, RD and ND trajectory classes had same intercept, but vastly different slopes. So, slope can be used to index responsiveness.
- Only 2 classes had significant quadratic term.
  - For fall tutoring, growth decelerated across year.
  - For spring tutoring-necessary, growth accelerated across year.

Conclusions

- 3rd-grade WID and PC measures distinguished RD from ND; WA did not.
- Spring tutoring-unnecessary RD students did not have a typical RD profile with poor WID skills. Instead, did not have a characteristically RD profile.
- Spring tutoring-unnecessary NRD was a relatively pure group of NRD students. So, using WIF in fall semester of 1st grade to select children at-risk students may be efficient.

Conclusions

- For control RD students, reading comprehension skill was defining characteristic. Interesting because 1st-grade trajectory classes formed exclusively with WIF. Also, no way to distinguish control RD and NRD using intercept.

- 1st-grade cognitive predictors most useful for untreated students. For control students, low sound matching associated with RD; high vocabulary associated with NRD.

- Within treated students, RTI (trajectory class) was what distinguished RD from NRD, effectively overriding initial individual differences on sound matching and vocabulary.

The Course of Math Disability in First Grade: Latent Class Trajectories and Early Predictors

Lynn Fuchs, Don Compton, and Doug Fuchs

Sample

- 41 1st-grade classrooms in 10 (6 Title 1) schools (667 [92%] consented)
- Identified 139 low-study-entry students (lowest 21%) on Jordan's Story Problems, WJ Calculations, WJ Applied Problems, and CBM; randomly assigned to control (69) or tutoring (70)
- Identified 180 average-study-entry students
- Three groups comparable demographically. On all math measures, ASE group > LSE groups.
- End of grade 2, complete data on study variables for
  - 62 low-study-entry control students
  - 61 low-study-entry tutored students
  - 125 average-study-entry comparisons
- 27 weekly CBM-Computation measurements in 1st grade
- End 2nd grade, disability: <85 on latent variable of arithmetic (WRAT-3) and story problems (Jordan)

Measures

- First-Grade Progress Monitoring
  - CBM-Computation (2.5 min)

- Second-Grade Outcome
  - WRAT 3 - Arithmetic
  - Jordan's Story Problems
    - MD: < 85 on latent variable

- Cognitive Predictors
  - Language (WASI Vocab, WASI Similarities, Woodcock List Comp)
  - Phonological Processing (CTOPP Sound Matching)
  - Nonverbal Reasoning (WASI Block Design)
  - Processing Speed (WJ-R Cross Out)
  - WM (WMTB-Listening Recall)
  - Inattentive Behavior (SSRS-short form)

Sheet #30

CBM Computation 1

Name : _____ Date: _____

A 8 + 1	B 1 2 + 0	C 6 - 1	D 0 + 1	E 41 - 1
F 7 + 3	G 5 + 4	H 4 - 2	I 8 - 1	J 6 - 4
K 7 - 1	L 1 + 3	M 75 + 22	N 41 + 40	O 9 - 7
P 3 - 1	Q 4 + 2	R 7 - 3	S 99 - 8	T 6 - 0
U 6 - 2	V 2 + 7	W 5 2 + 2	X 0 + 6	Y 8 + 0

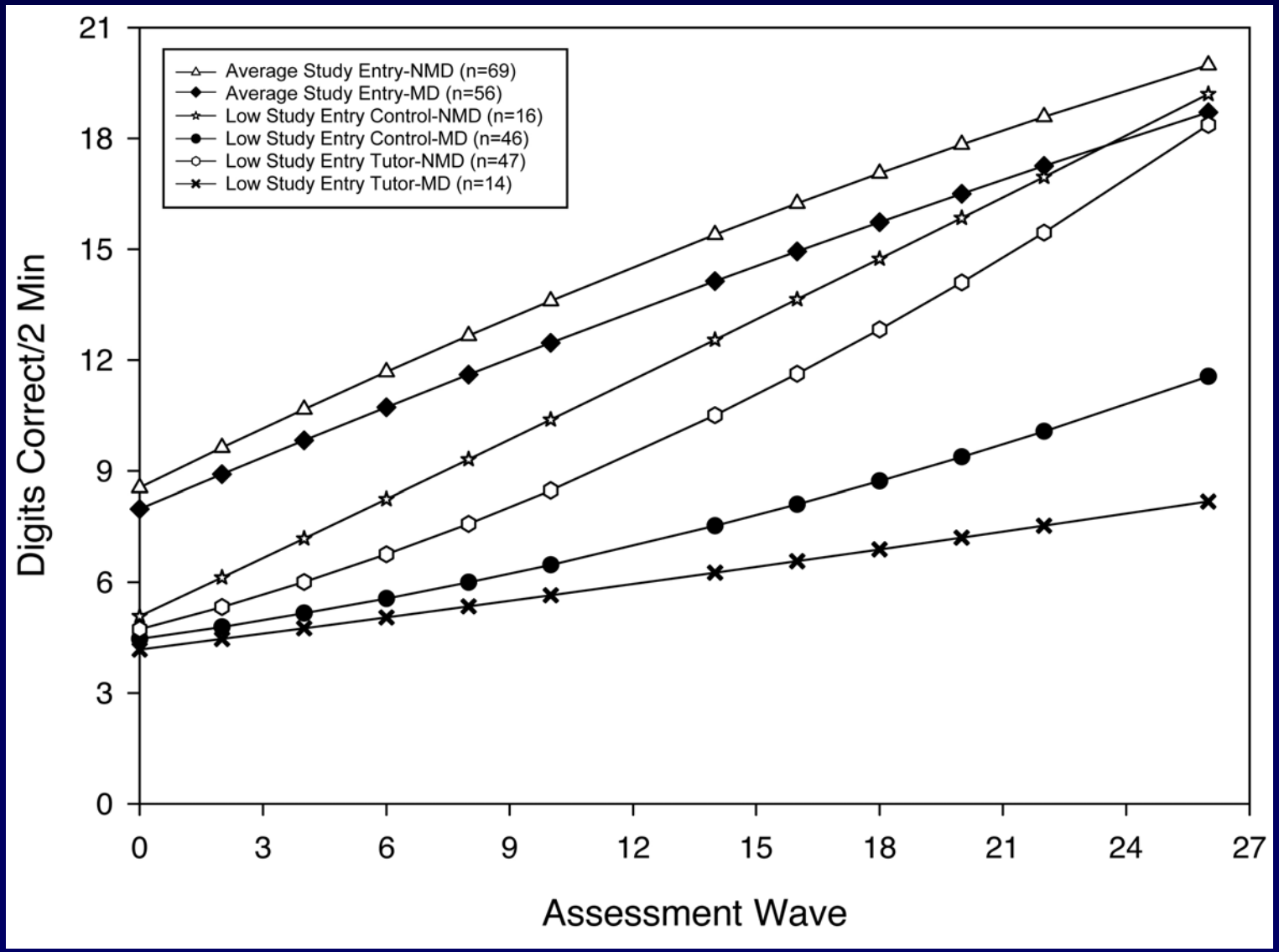
Tutoring

- 20 weeks
- Groups of 2-3, conducted by our master's students
- 40 min per session, outside classroom
- 30 min explicit instruction/session with manipulatives on 17 sequential topics (3-6 lessons per topic)
- 10 min computerized fact practice/session
- Audiotaped (6 sessions coded for fidelity: 95.6% beginning tutoring; 93.5% middle-end)

Results: Conventional Growth Modeling (across entire sample)

- CBM-Computation
- 27 weekly across fall and spring (used every other data point in analyses)
- Quadratic model improved overall fit of model over linear model
- I: 6.11 digits (SE=0.226; z = 27.02)
- S: 0.28 digits per week (SE=0.039; z = 7.08)
- Q: 0.005 digits^2 per week (SE=0.001; z = 3.12)

Results: Growth Mixture Modeling



Results: Growth Mixture Modeling

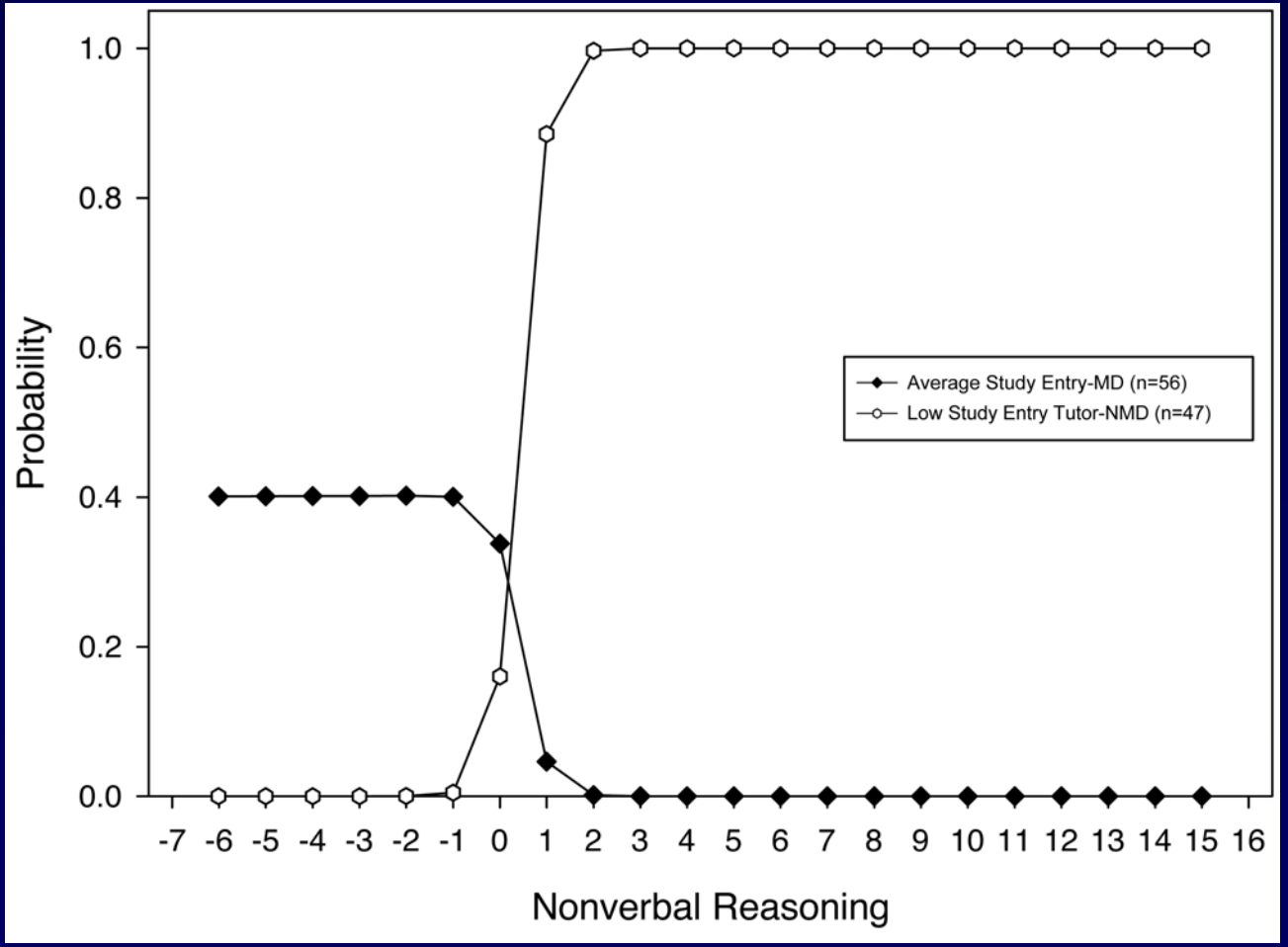
- For each trajectory class, intercept was significantly greater than zero.
- Slope was significantly greater than zero for all groups except control MD ($z = 0.488$) and tutoring MD ($z = 0.040$)
- Quadratic term significantly different from zero only for tutoring NMD, with acceleration ($z = 2.816$)

Results: Growth Mixture Modeling

- Latent class probability: Probability child is assigned to correct disability trajectory class within the known class: .963 to .989 (precise)

- Class-specific profiles on the 2nd-grade latent class indicators: Probability child in that class would score above 85
  - WRAT Arithmetic: poor precision.
  - Jordan's Story Problems: More consistently distinguished MD from ND.
  - Poor story problem performance was the defining characteristic of both low-study-entry MD groups (control and tutored).
  - For average-study-entry MD group, high class probability of scoring normal on WRAT-Arithmetic and Jordan's Story Problems. So, this group represents a lower growth ND group.

Estimated Multinomial Regression of Latent Class Variable on Covariates



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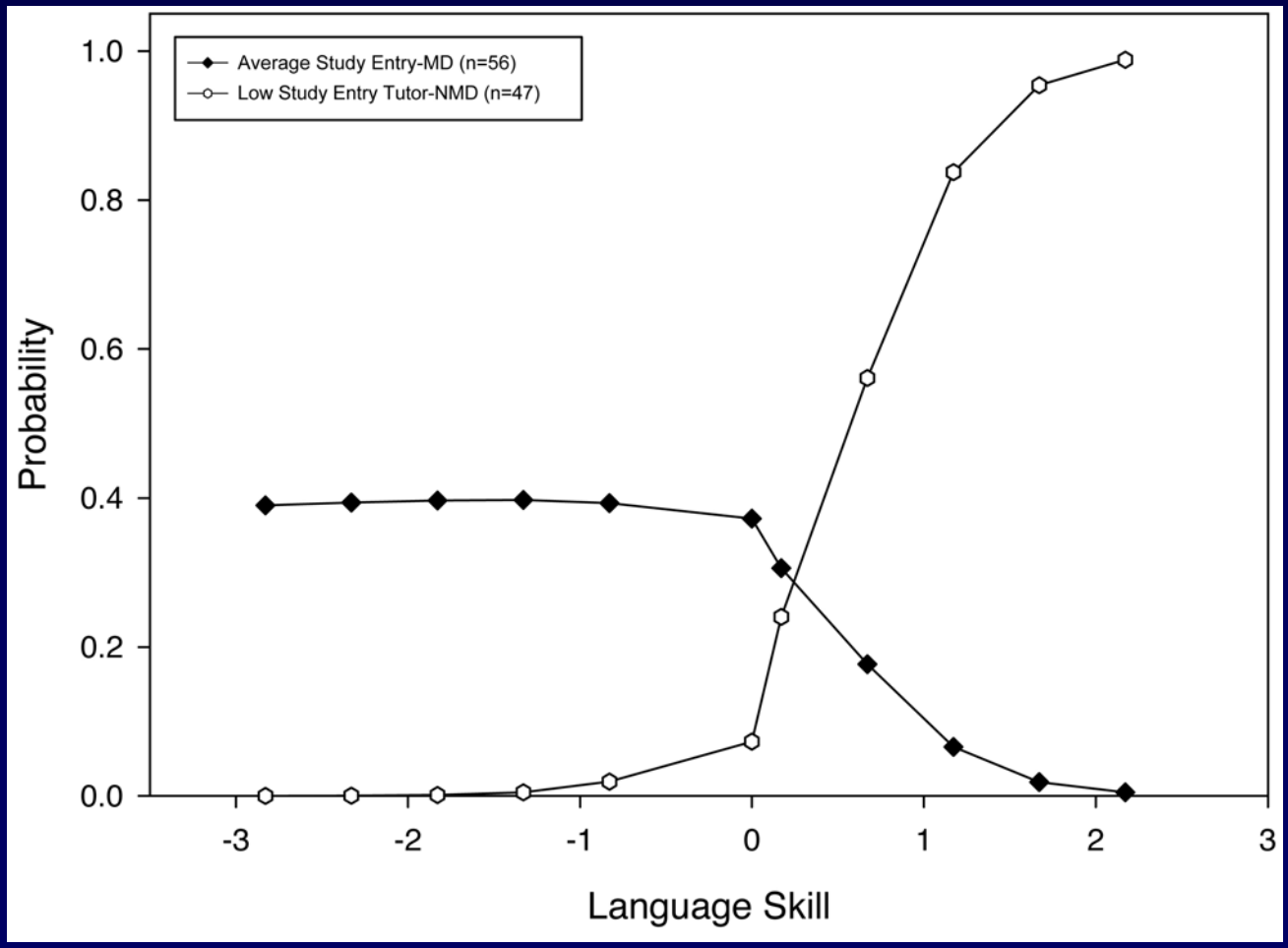

Plots represent estimated class-specific probability of class membership as function of one covariate, while keep other covariates constant

- Only language and nonverbal reasoning discriminated latent class membership.
- High scores on each measure were associated with greater probability of membership in tutoring ND.
- Lower scores were associated with greater probability of membership in average-study-entry MD group (which was a lower slope group with few students actually classified as MD).

MD Status at End of Grade 2

- Overall, 49% of low-study entry classified as MD.
  - Control group: 74%
  - Tutoring group: 23%

- Control students were disproportionately classified in the MD trajectory classes, X^2 (1, N=123) = 32.32, $p < .001$.

Conclusions

- First-grade trajectory classes associated with 2nd-grade disability status can be identified with high precision using CBM-COMP. So, CBM-COMP can be used for 1st-grade progress monitoring within RTI as indicator of long-term MD status.

- Neither low-study-entry MD group exhibited significant slope. So, slope can be used to index responsiveness to classroom instruction (in case of control) or to classroom instruction plus tutoring (in case of tutored).

- Only 1 class had significant quadratic term.
  - For tutoring NMD class, growth accelerated across year.

- Results indicate that tutoring had substantial power to reduce prevalence of MD at end of 2nd grade, compared to low-study-entry students who did not receive tutoring.

Conclusions

- 2nd-grade story-problem skill distinguished MD from ND; WRAT-Arithmetic did not.
- This suggests that poor story-problem skill is a defining characteristics of MD.
- Interesting because trajectory classes formed on basis CBM that indexed computational skill. These growth functions strongly associated with risk for developing later story-problem competence.
- So, using CBM-COMP in 1st grade may be efficient to select at-risk children.
- Students in the average-study entry MD trajectory class were not identified as MD on WRAT or on Story Problems at end of 2nd grade. So, it does not represent MD per se, but rather a low normal trajectory class with typically developing children. These children show a relative, not an absolute, weakness in story-problem performance at end of 2nd grade. So, higher intercept students do not require progress monitoring.

Conclusions

- For tutored students, higher scores on language and nonverbal reasoning were associated with a greater probability of ND.

- This makes sense, given that story-problem skill was the more robust determinant of disability class membership (not calculations).

Conclusions Across Studies 2-3

- Modeling reading or math development within 1st grade can identify 1st-grade trajectory classes with high precision, which are highly associated with outcomes at end-of-3rd-grade passage comprehension or end-of-2nd-grade story problems.

- Growth functions vary as a function of known class (e.g., receiving tutoring or not) and unobservable class (e.g., MD or ND). For ex., in both studies, low-study-entry children identified in the ND trajectory classes exhibited acceleration in response to tutoring, whereas low-study-entry children identified in the RD/MD trajectory classes exhibited no acceleration (and in math, no significant linear slope). In reading, growth to tutoring is a better determinant of disability status compared to initial intercept.

Conclusions Across Studies 2-3

- Findings corroborate importance of skill development over the course of 1st grade, both in the presence and absence of preventative tutoring, for determining later performance.

- Findings also help practitioners understand how adequate reading and math performance unfolds across 1st grade.

- Although 1st-grade PM measures were on foundational skills, later outcomes associated with those 1st-grade trajectories better represented more complicated, higher-order function: comprehension or problem solving.

Conclusions Across Studies 2-3

- Findings indicate that the course of 1st-grade development is not fixed. Schools have the capacity to alter those trajectories.

- Results show that tutoring for students who enter 1st grade with low trajectories changed the course of development, moving students from trajectory classes associated with disability to trajectory classes associated with better outcomes.

Conclusions Across Studies 2-3

- About predictors,
  - Reading: Phonological processing and oral vocabulary emerged as important for distinguishing RD from ND within the control group. For the two tutoring groups, RTI was what distinguished the two groups, effectively overriding the effects of initial deficits.
  - Math: Language and nonverbal reasoning were the key predictors. This is understandable in light of the fact that 2nd-grade disability status was driven by story-problem performance.