Evaluating an Agent-Based Model: Evaluation Practice Meets Research on Evaluation

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Large-Scale Agent-Based Simulation of Complex Educational Systems

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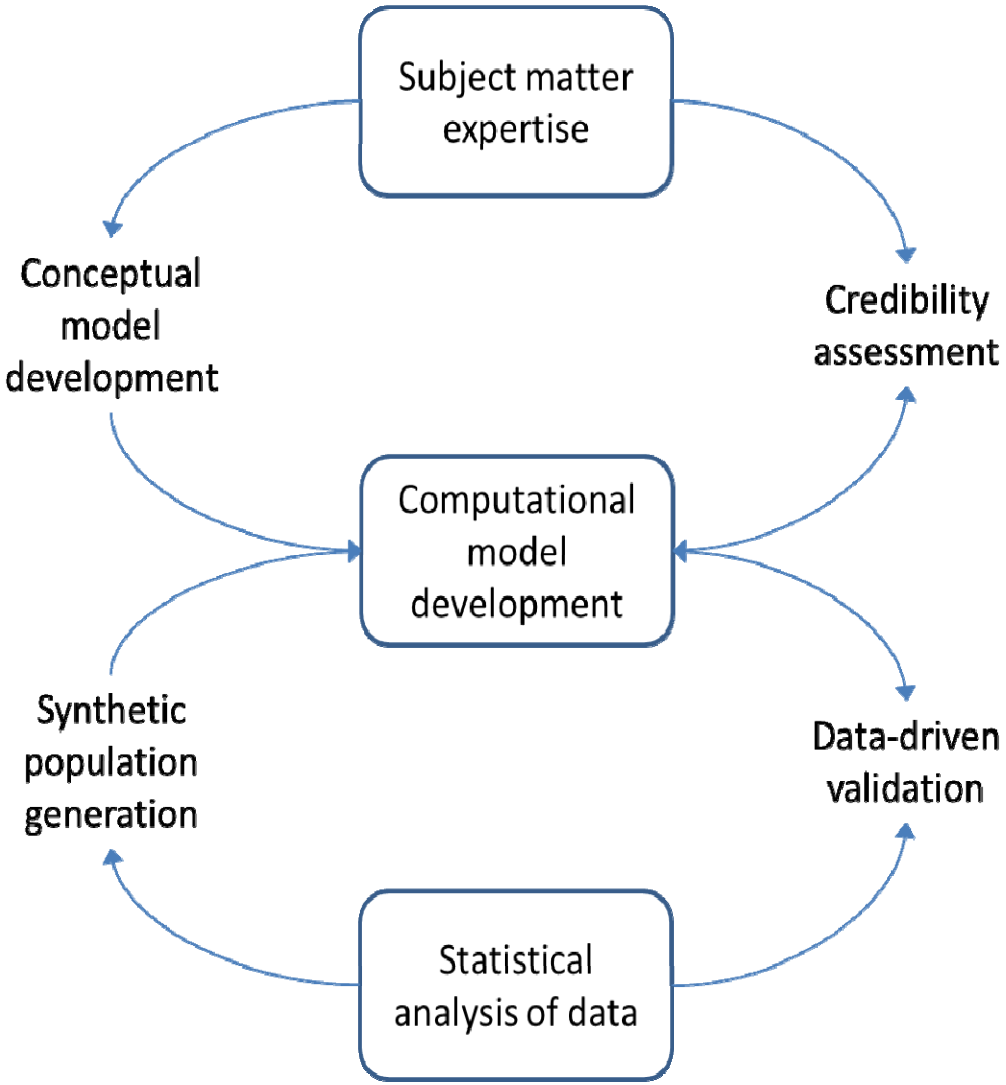
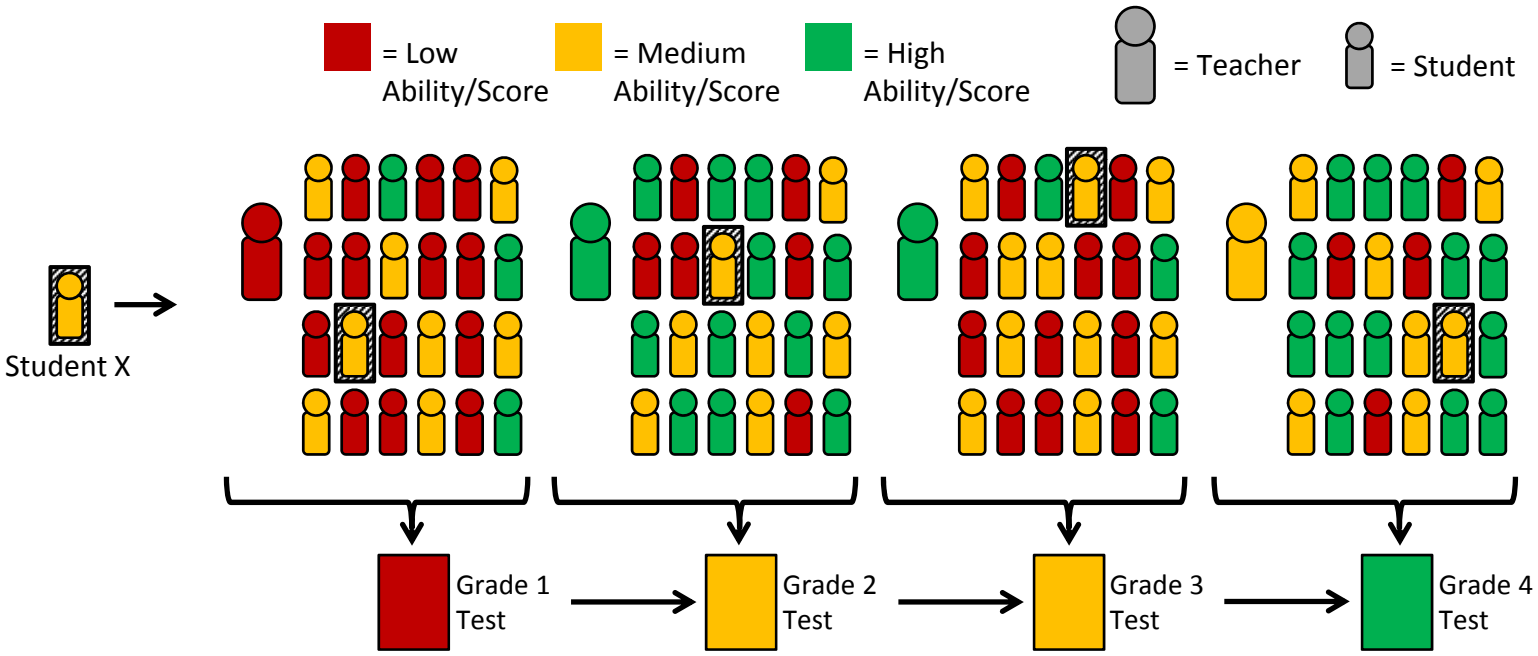
What are we up to?

model development process



Model 1

Visual representation of score assignment



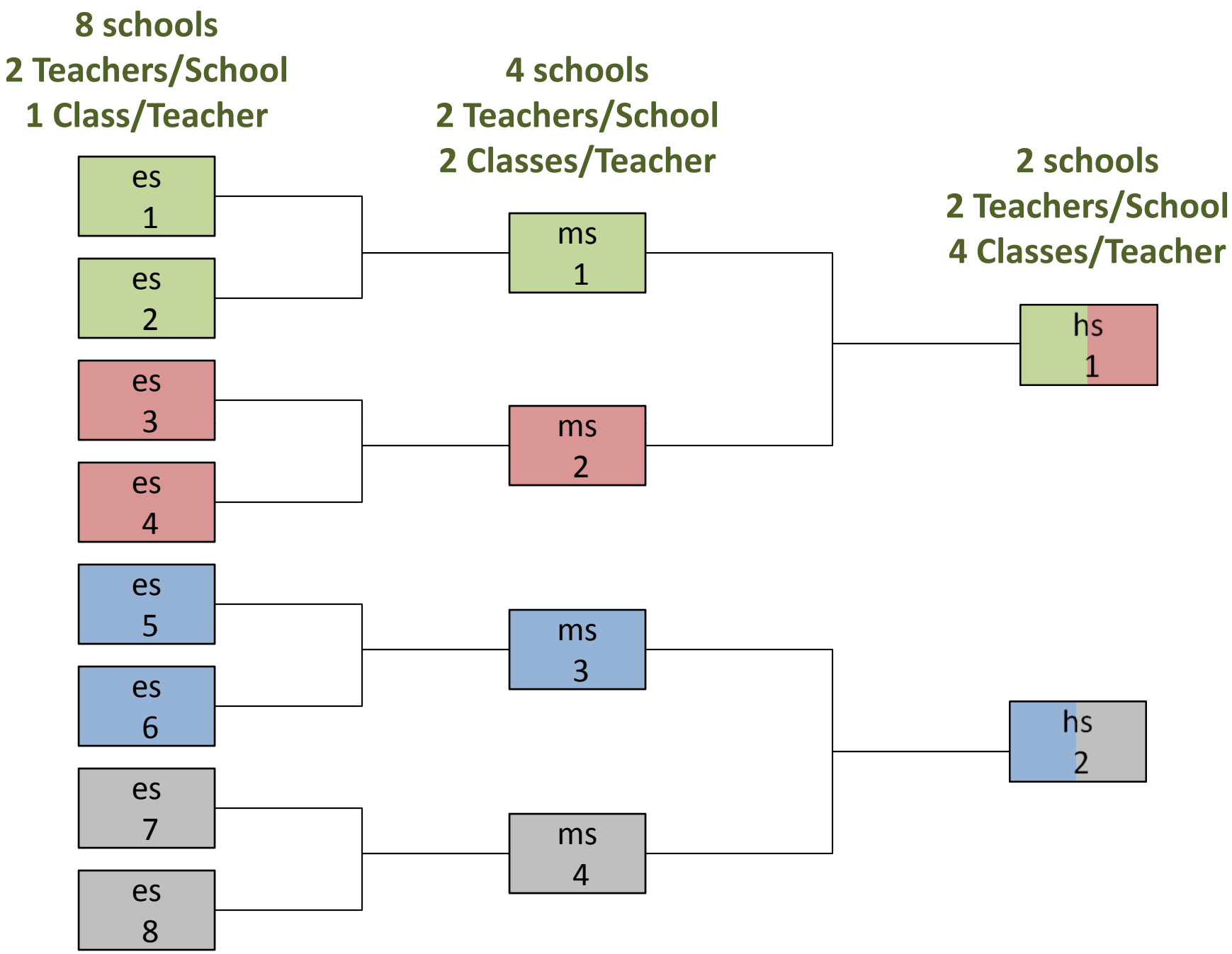
Student score function

- **Score Assignment Notation**
  - X_k^g = Score for student *k* at grade level *g*
  - A_k = Baseline ability for student *k* to learn the material
  - T = Baseline ability for the teacher to teach the material
  - N = Number of students in the classroom
  - w_i = Calibration Weights

$$X_k^g = \frac{1}{4}\left[w_1 A_k + w_2 T + w_3 \frac{1}{N}\sum_{j=1}^{N} A_j + w_4 X_k^{g-1} \right]$$

For the first iteration, we only average over first three terms.

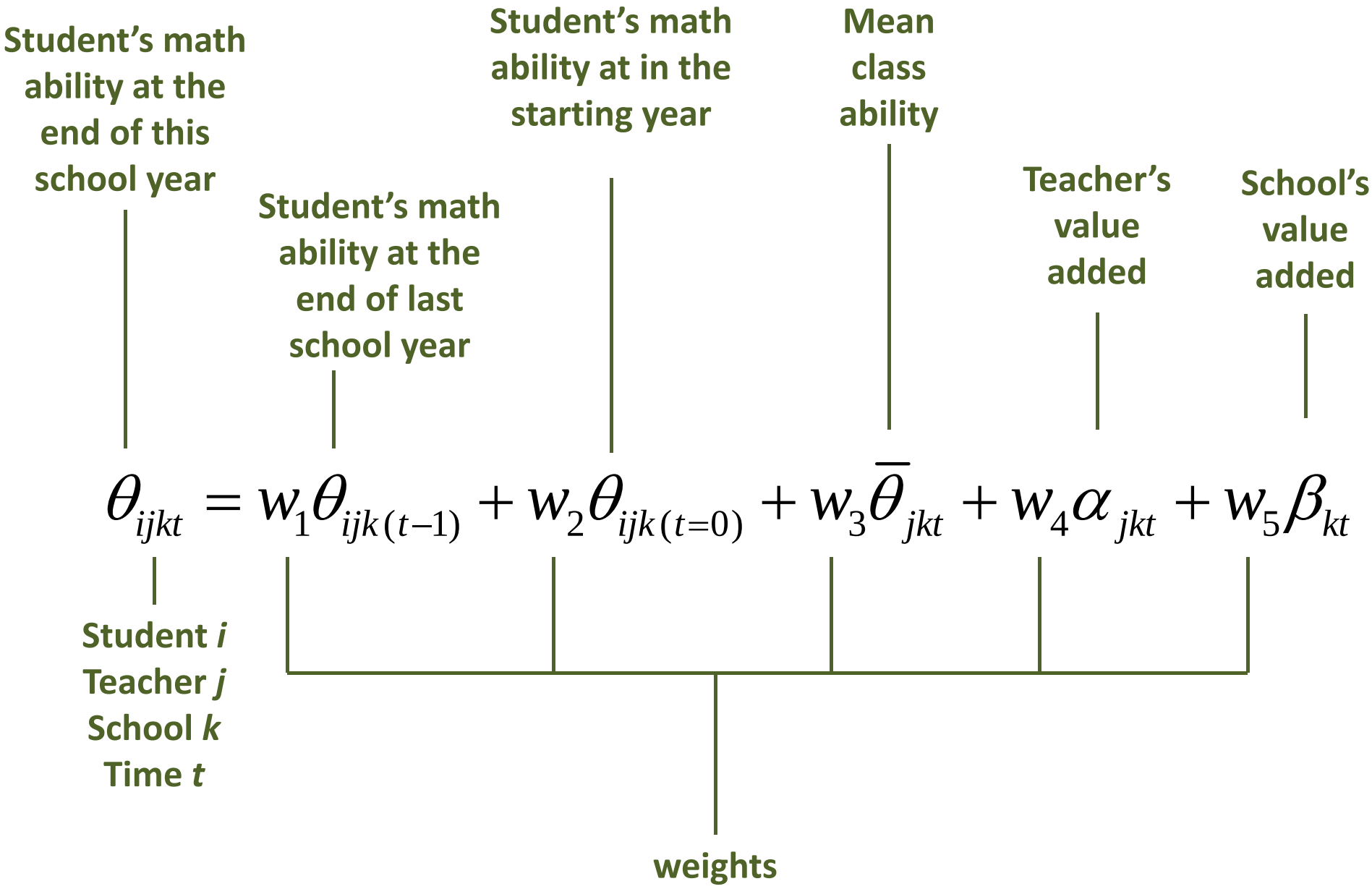
Model 2


8 schools
2 Teachers/School
1 Class/Teacher
4 schools
2 Teachers/School
2 Classes/Teacher
2 schools
2 Teachers/School
4 Classes/Teacher
es 1
es 2
es 3
es 4
es 5
es 6
es 7
es 8
ms 1
ms 2
ms 3
ms 4
hs 1
hs 2

Abilities
(True Scores)

versus

Observed
Test Score


Student's math ability at the end of this school year
Student's math ability at the end of last school year
Student's math ability at in the starting year
Mean class ability
Teacher's value added
School's value added
$\theta_{ijkt} = w_1\theta_{ijk(t-1)} + w_2\theta_{ijk(t=0)} + w_3\bar{\theta}_{jkt} + w_4\alpha_{jkt} + w_5\beta_{kt}$
Student *i*
Teacher *j*
School *k*
Time *t*
weights

$$\theta_{ijkt} = w_1\theta_{ijk(t-1)} + w_2\theta_{ijk(t=0)} + w_3\bar{\theta}_{jkt} + w_4\alpha_{jkt} + w_5\beta_{kt}$$

w_1= [1-(grade level /12)]* Constant

w_2=(grade level /12)*Constant

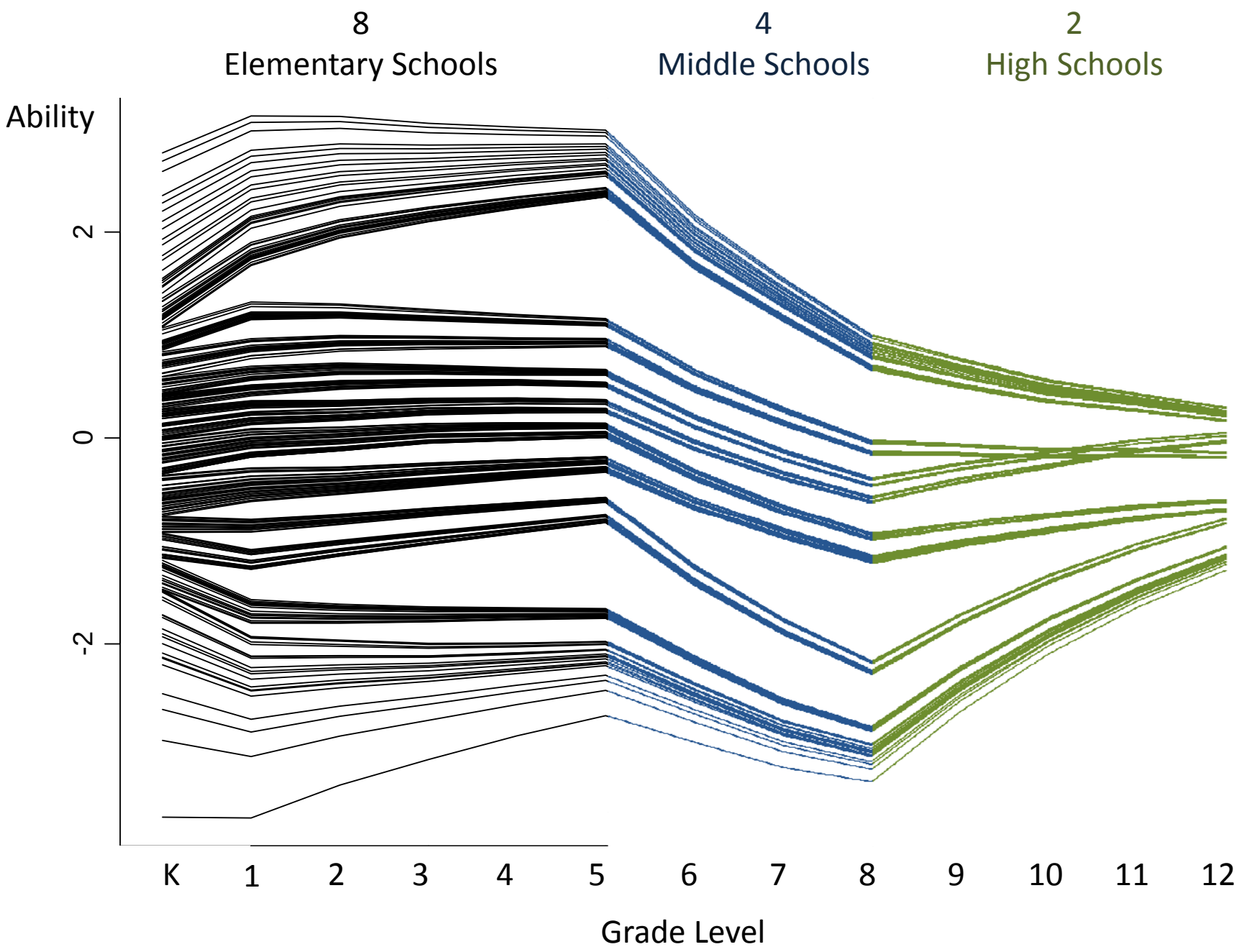
w_3=Constant

w_4=Constant

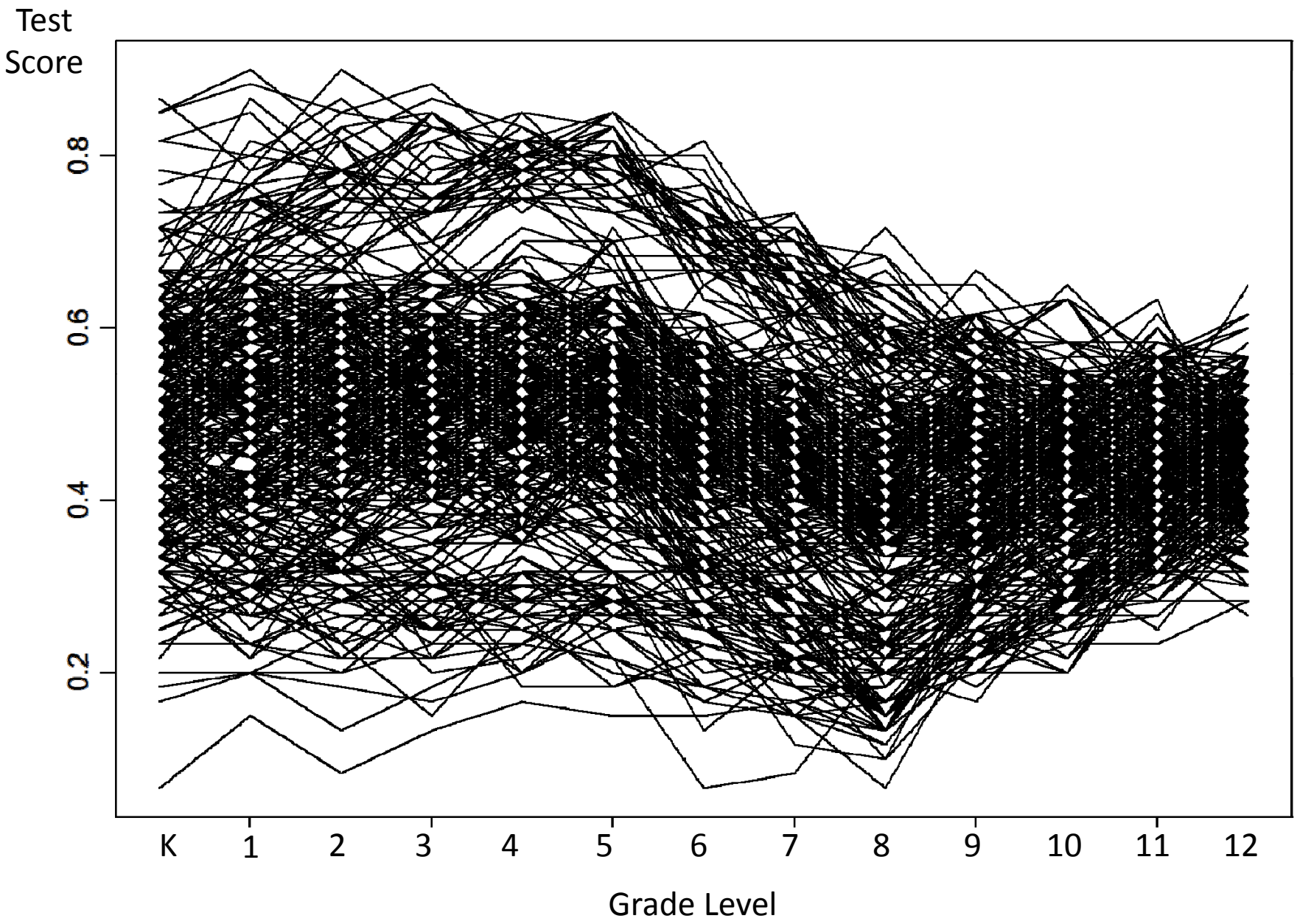
w_5=Constant

Exaggerated Model

Exaggerated Model (Abilities)



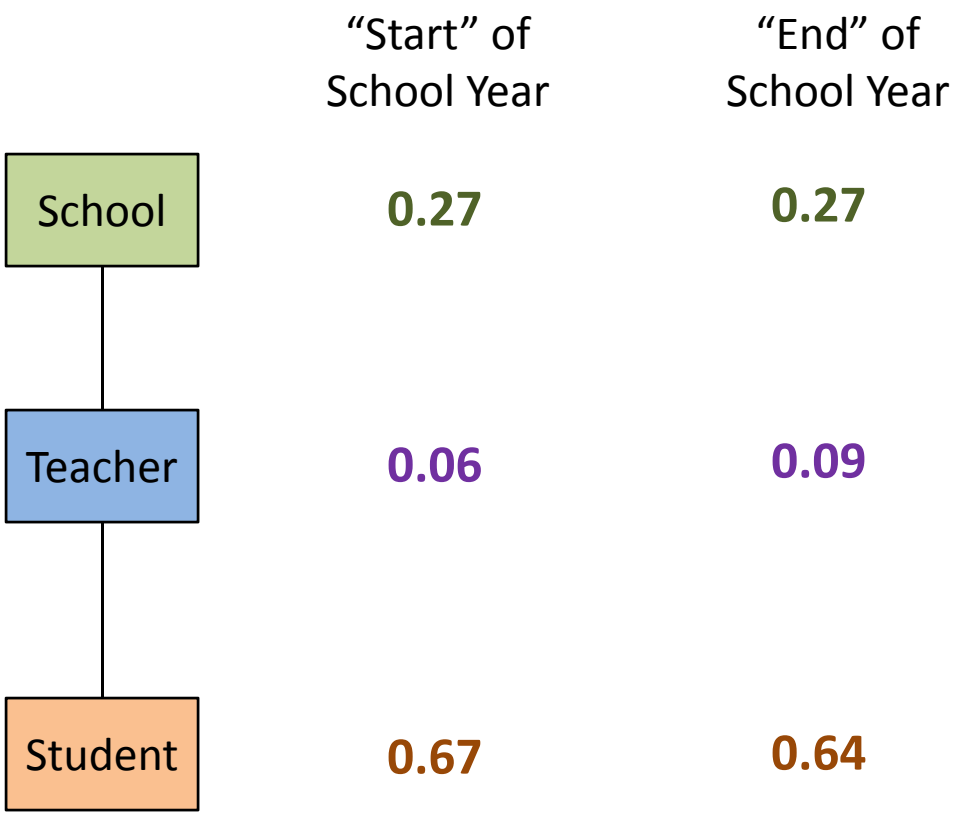
Exaggerated Model (Observed Test Scores)



Systems Models Informed by Data

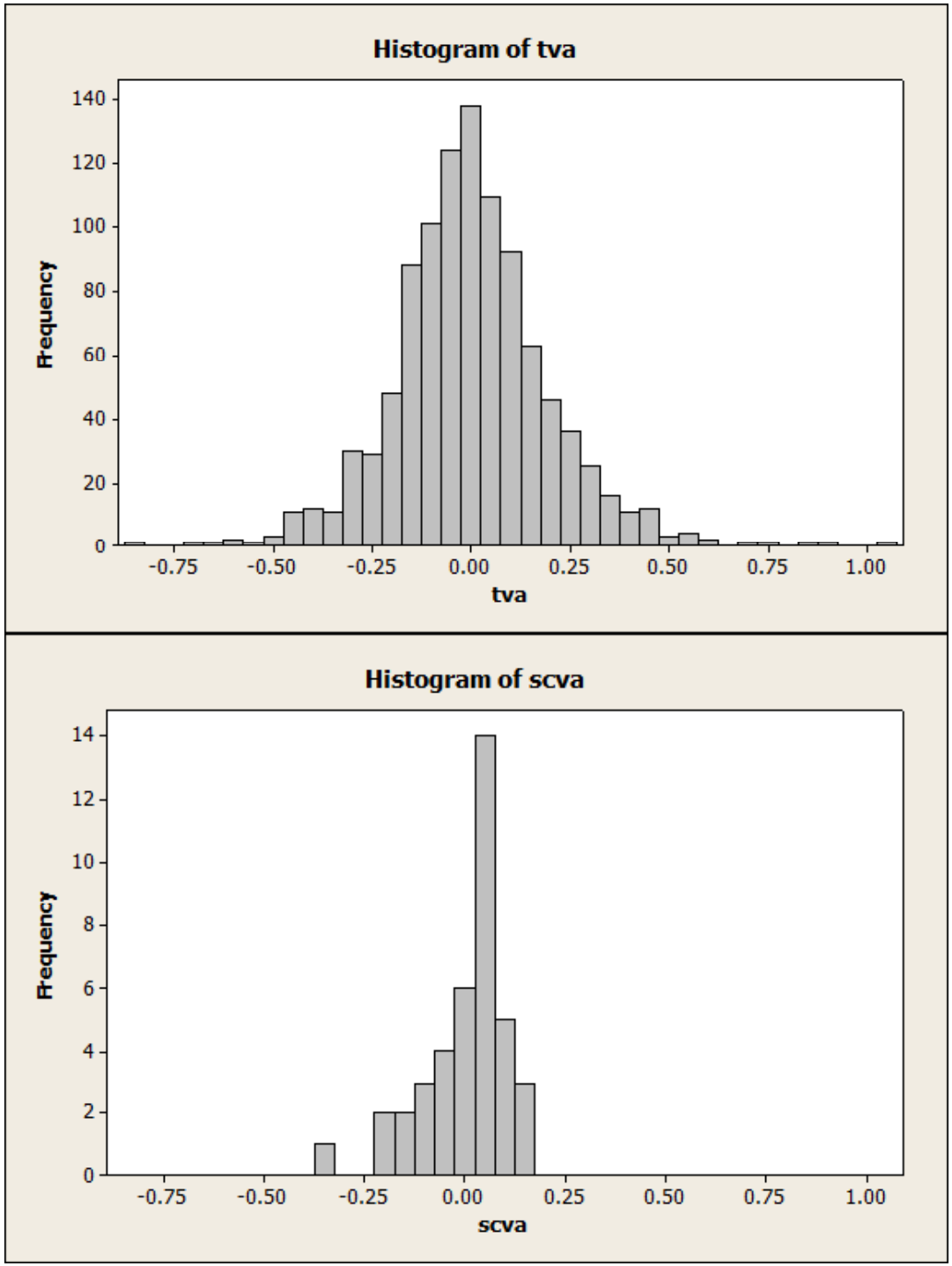
Used a variety of
multi-level models (HLMs)
to estimate a
variety of parameters

Proportion of Variance in Test Scores at Each Level

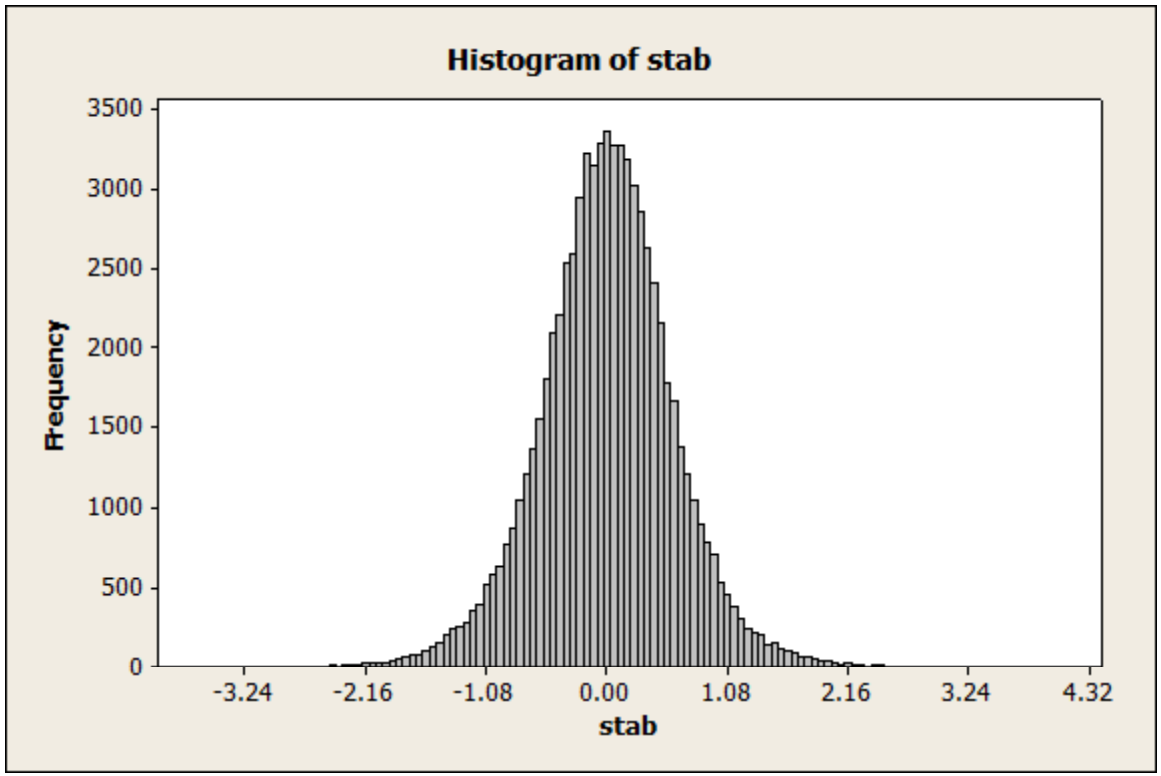


Teacher VA

School VA

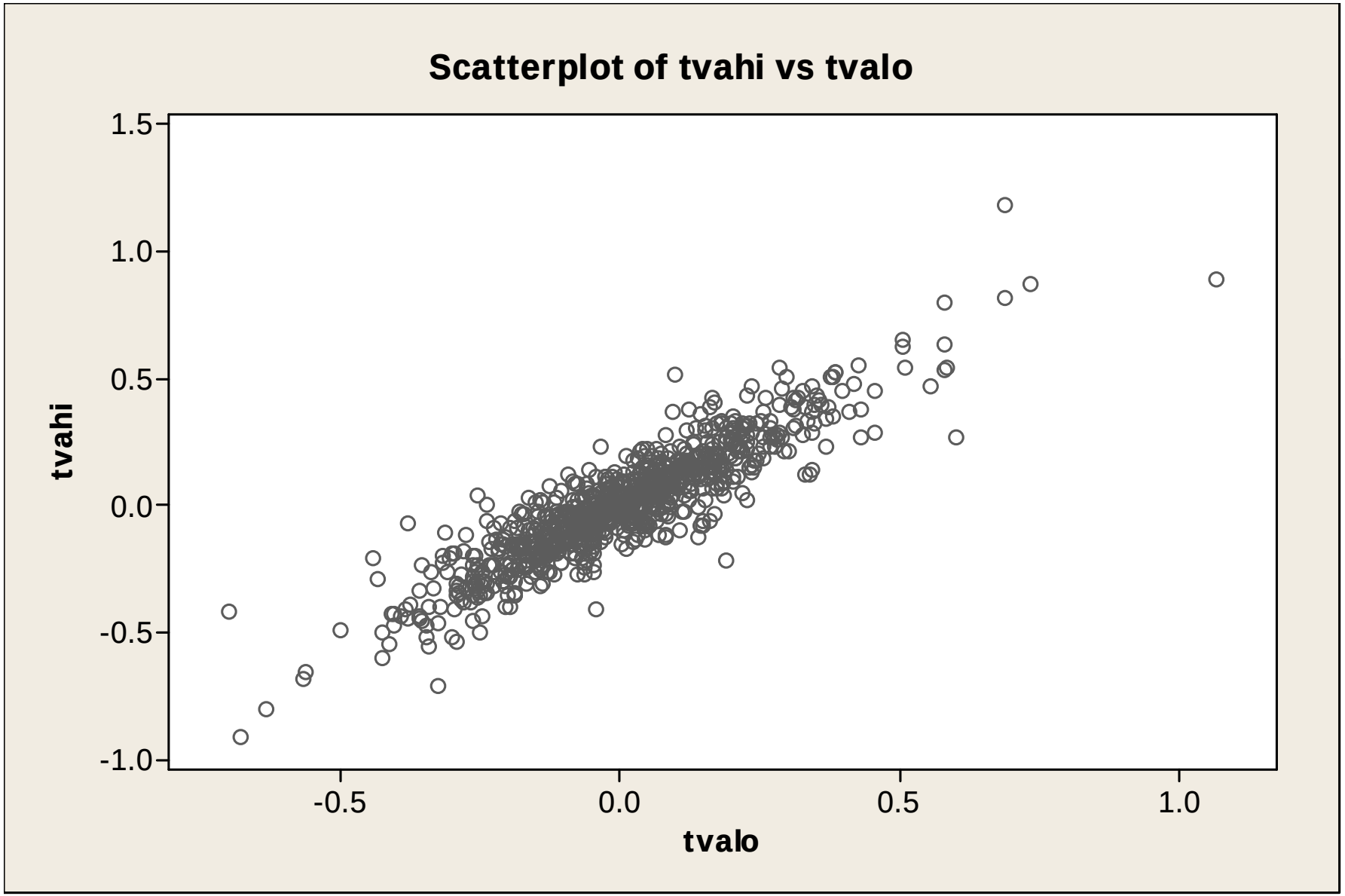


Student VA


Histogram of stab
Frequency
3500
3000
2500
2000
1500
1000
500
0
-3.24
-2.16
-1.08
0.00
1.08
2.16
3.24
4.32
stab

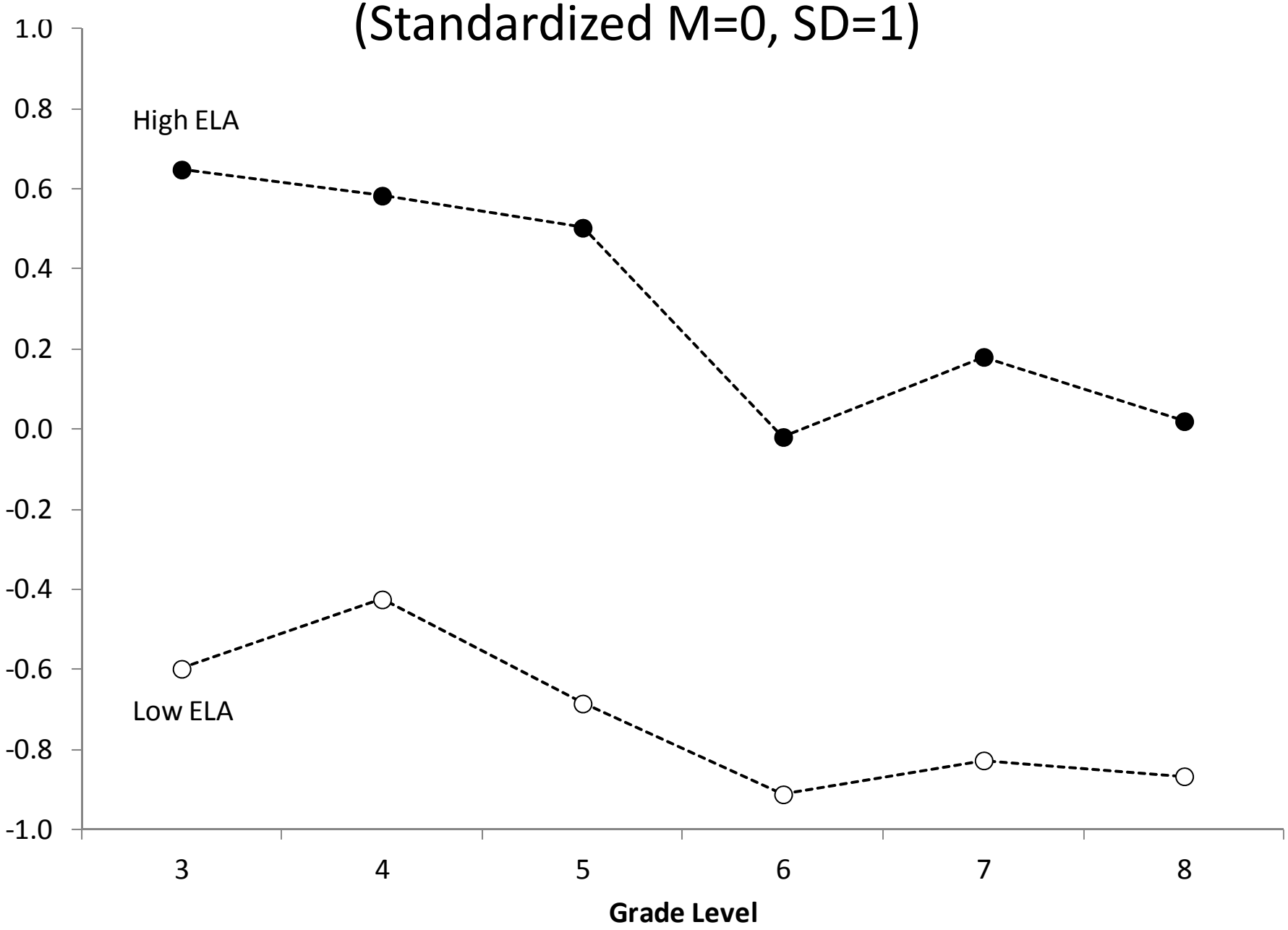
VA for ELA
High & Low Groups

- averaged ELA scores over all years
- LOW ELA = bottom 1/3 of students
- HIGH ELA = top 2/3 of students


Scatterplot of tvahi vs tvalo
tvahi
1.5
1.0
0.5
0.0
-0.5
-1.0
-0.5
0.0
0.5
1.0
tvalo

Mean Math Scores Over Time

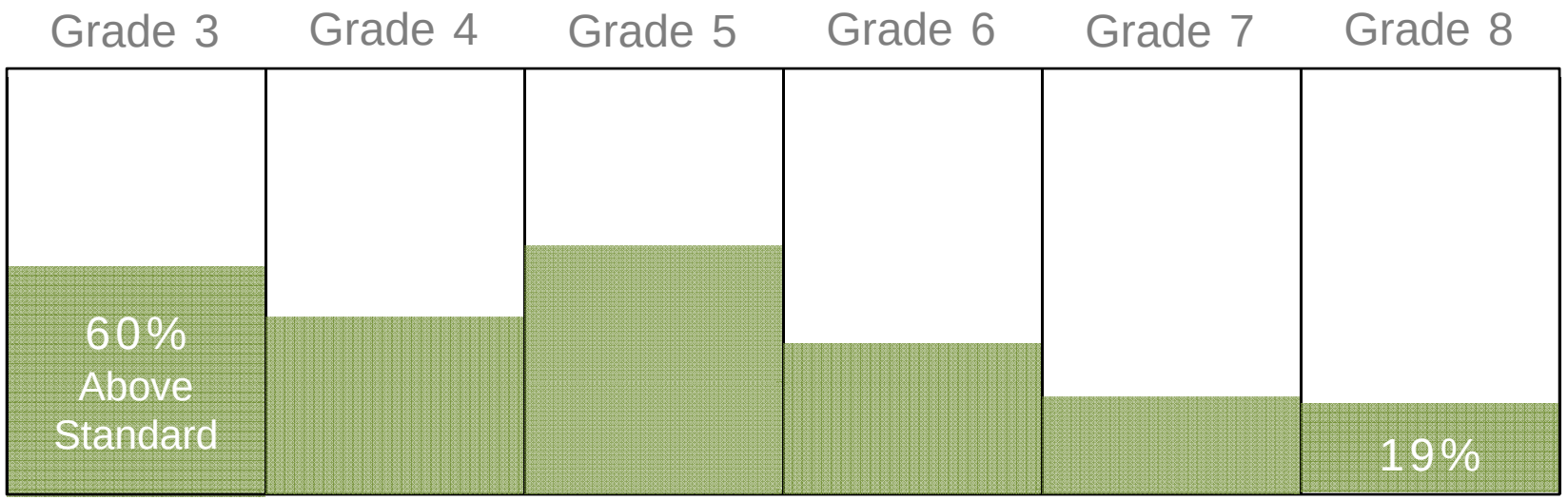
(Standardized M=0, SD=1)



Matching Students with Teachers

Fixed Effect	Coefficient	Standard Error	T-ratio	Approx. d.f.	P-value
For LOWELA slope, P1					
For INTRCPT2, B10					
INTRCPT3, G100	-0.118530	0.012738	-9.305	39	0.000
For VALO33, B11					
INTRCPT3, G110	0.355074	0.015701	22.615	1023	0.000
For HIELA slope, P2					
For INTRCPT2, B20					
INTRCPT3, G200	-0.171179	0.023128	-7.401	39	0.000
For VAHI33, B21					
INTRCPT3, G210	0.377650	0.016493	22.897	1023	0.000

Evaluating Utility



Professional Development for Teachers

Which teachers receives it?

- (●) weakest teachers
- ( ) any teacher

Percent of all teachers who receive it?

30%

Matching

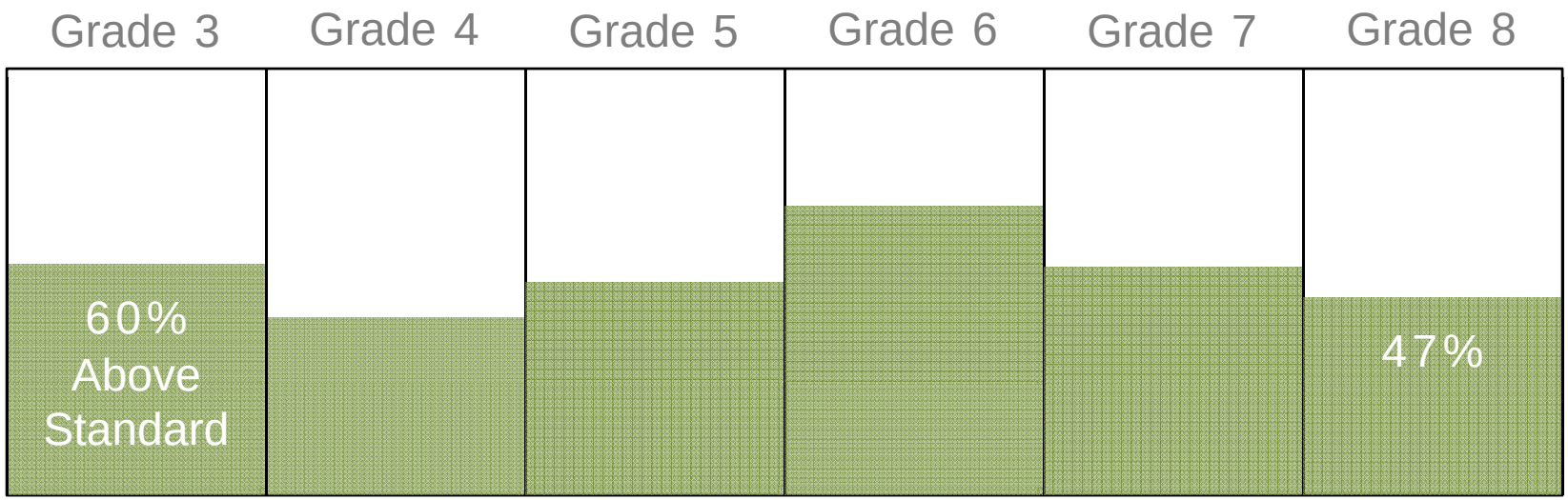
Percentage

Students matched to teachers — 90%

Students matched to students — 60%

Results

Simulation 1: 19%



Professional Development for Teachers

Which teachers receives it?

- (●) weakest teachers
- ( ) any teacher

Percent of all teachers who receive it?

70%

Matching

Percentage

Students matched to teachers: 90%

Students matched to students: 60%

Results

Simulation 1: 19%

Simulation 2: 47%

Thank You