

Examining the Effects of Gifted Classes on Mathematics and Reading/Language Arts Achievement.

Presentation at SREE 2020 in the

*Causal Inference in Clustered Observational Studies using Optimal Multilevel
Matching Symposium*

By

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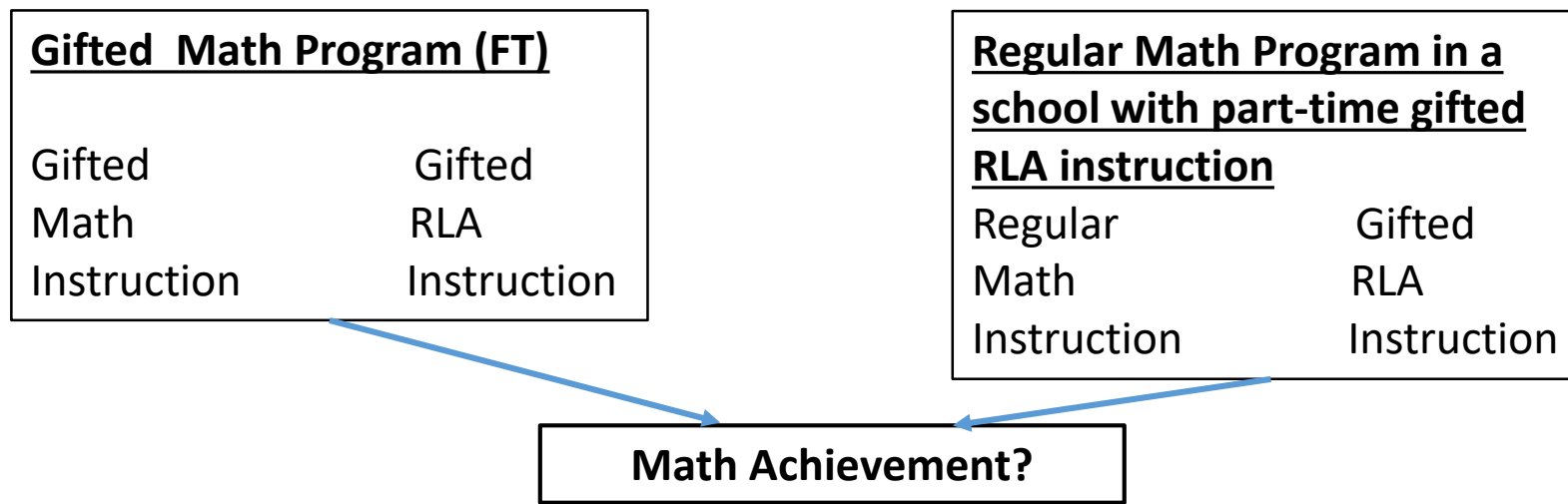
Research Question

What is the effect of language arts and mathematics gifted classes on academic achievement of gifted students?

How well does optimal multilevel matching with network flows address selection in a clustered observational study?

Analytical Approach – Clustered Observational Study

1. We compare the academic achievement in two different groups of schools. One group of schools has gifted content instruction versus a group of schools that does not have gifted content instruction.
2. The school district we are examining allows schools to choose whether they provide gifted instruction in one of three formats:
 1. Full time gifted instruction in both reading/language arts (RLA) and mathematics
 2. Part time gifted instruction in only mathematics and regular instruction in RLA
 3. Part time gifted instruction in only reading/language arts and regular instruction in Math
3. To examine the effect of a given content area, e.g. math, we could compare the math achievement of gifted students in schools with full time gifted instruction vs. only language arts gifted instruction.



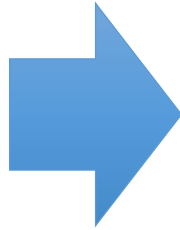
Full-Time Gifted
Academic Content
Program
*Cohort 1 n=81/
Cohort 2 n=80
schools*



GT Reading/LA

GT Math

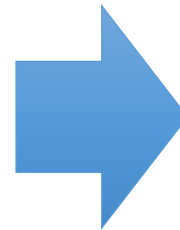
Part-Time Gifted in
Mathematics
Academic Content
Area
n=11/14 schools



Regular Reading/LA

GT Math

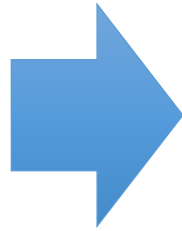
Part-Time Gifted in
Reading/LA
Academic Content
Area
n=30/31 schools



GT Reading/LA

Regular Math

Full-Time Gifted
Academic Content
Program
n=81/80 schools



Gifted Students

GT Reading/LA

GT Math

Part-Time Gifted in
Mathematics
Academic Content
Area
n=11/14 schools



Regular Reading/LA

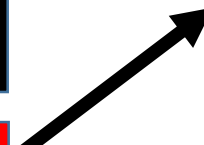
GT Math

Part-Time Gifted in
Reading/LA
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n=30/31 schools



GT Reading/LA

Regular Math



**Effect of Gifted Math
Program in Full-Time
Schools
On
Math
Achievement**

Full-Time Gifted
Academic Content
Program
n=81/80 schools

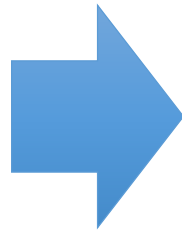


Gifted Students

GT Reading/LA

GT Math

Part-Time Gifted in
Mathematics
Academic Content
Area
n=11/14 schools



Regular Reading/LA

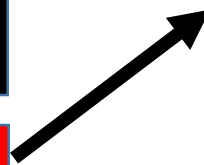
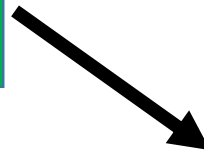
GT Math

Part-Time Gifted in
Reading/LA
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Area
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GT Reading/LA

Regular Math



**Effect of Gifted Math
Program in Part-Time
Schools
On
Math Achievement**

Full-Time Gifted
Academic Content
Program
n=81/80 schools

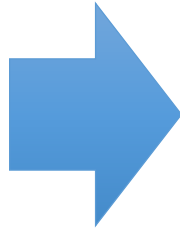


Gifted Students

GT Reading/LA

GT Math

Part-Time Gifted in
Mathematics
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Area
n=11/14 schools



Regular Reading/LA

GT Math

Part-Time Gifted in
Reading/LA
Academic Content
Area
n=30/31 schools



GT Reading/LA

Regular Math

**Effect of Gifted Language
Arts Program in Full-Time
Schools
On
Language Arts
Achievement**

Full-Time Gifted
Academic Content
Program
n=81/80 schools

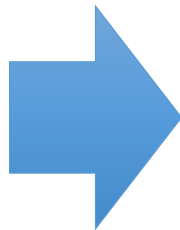


Gifted Students

GT Reading/LA

GT Math

Part-Time Gifted in
Mathematics
Academic Content
Area
n=11/14 schools



Regular Reading/LA

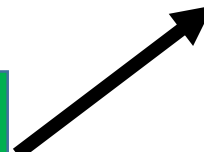
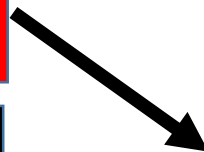
GT Math

Part-Time Gifted in
Reading/LA
Academic Content
Area
n=30/31 schools



GT Reading/LA

Regular Math



**Effect of Gifted Part-Time
Program in Part-Time
Schools
On
Language Arts
Achievement**

Causal Comparisons for Two Subjects

Subject	Treatment	Control	Comparison	Outcome
Mathematics	Gifted Math Program in Full-Time Schools	No Gifted Math Program in Part-Time Language Arts Schools	Gifted Math (FT) vs. Regular Math	Math Achievement
	Gifted Math Program in Part-Time Math Schools	No Gifted Math Program in Part-Time Language Arts Schools	Gifted Math (PT) vs. Regular Math	Math Achievement
Language Arts	Gifted Language Arts Program in Full-Time Schools	No Gifted Language Arts Program in Part-Time Math Schools	Gifted LA (FT) vs. Regular LA	Language Arts Achievement
	Gifted Language Arts Program in Part-Time Language Arts Schools	No Gifted Language Arts Program in Part-Time Math Schools	Gifted LA (PT) vs. Regular LA	Language Arts Achievement

Data

1. A diverse urban southern school district where some schools in the district provide full time gifted instruction (i.e. instruction in both mathematics and language arts) and other schools only provide gifted instruction in mathematics only or language-arts only.
2. Data from gifted students from 2nd to 5th grade for the 17/18 5th grade cohort and the 16/17 5th grade cohort
2. Data on type of gifted program in the school (full time, part-time math, or part-time language arts)
4. Dependent Variable = 5th or 4th grade score on Math or Language Arts State Assessment (We also examined the gain scores in Math or RLA but these results are not shown.)

Covariates

I. Student Level

1. Free-Reduced Price Lunch (FRPL) Status,
2. English Learner (EL) Status,
3. Female
4. Race/Ethnicity (White is the reference group):
 - A. Black,
 - B. Hispanic,
 - C. Asian,
 - D. Other
5. 2nd grade math and Reading/Language Arts(RLA) achievement at the student level

II. School Level

1. %gifted,
2. %EL,
3. % FRPL,
4. % Female
5. % Black, % Hispanic,% Asian, % Other,
6. average 2nd grade math and RLA scores at the school level

Program Selection Effects

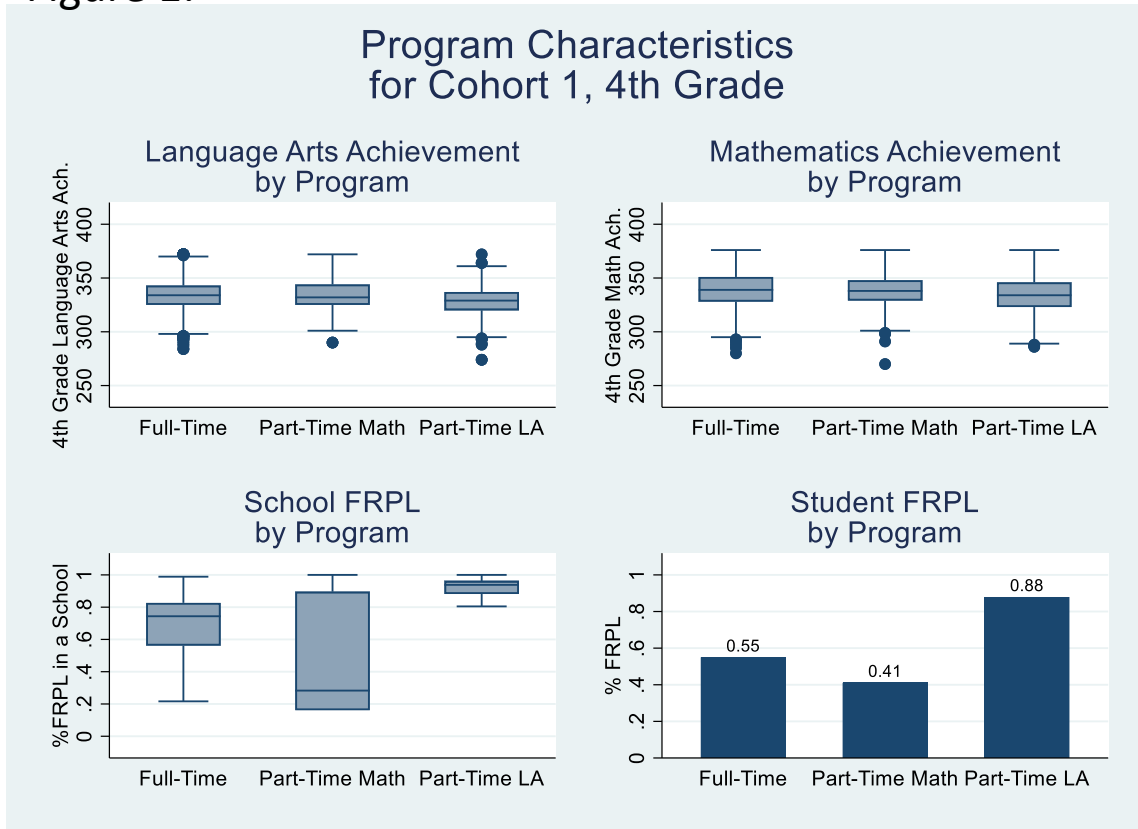
How do different types of gifted programs differ in the district?

Are there systematic differences between full time gifted programs versus part-time Math and part-time language arts programs?

Large Selection Effect Across Different Types of Programs

Academic Achievement, School Poverty, and Student Poverty by type of Gifted Program for 4th -grade

Figure 1:



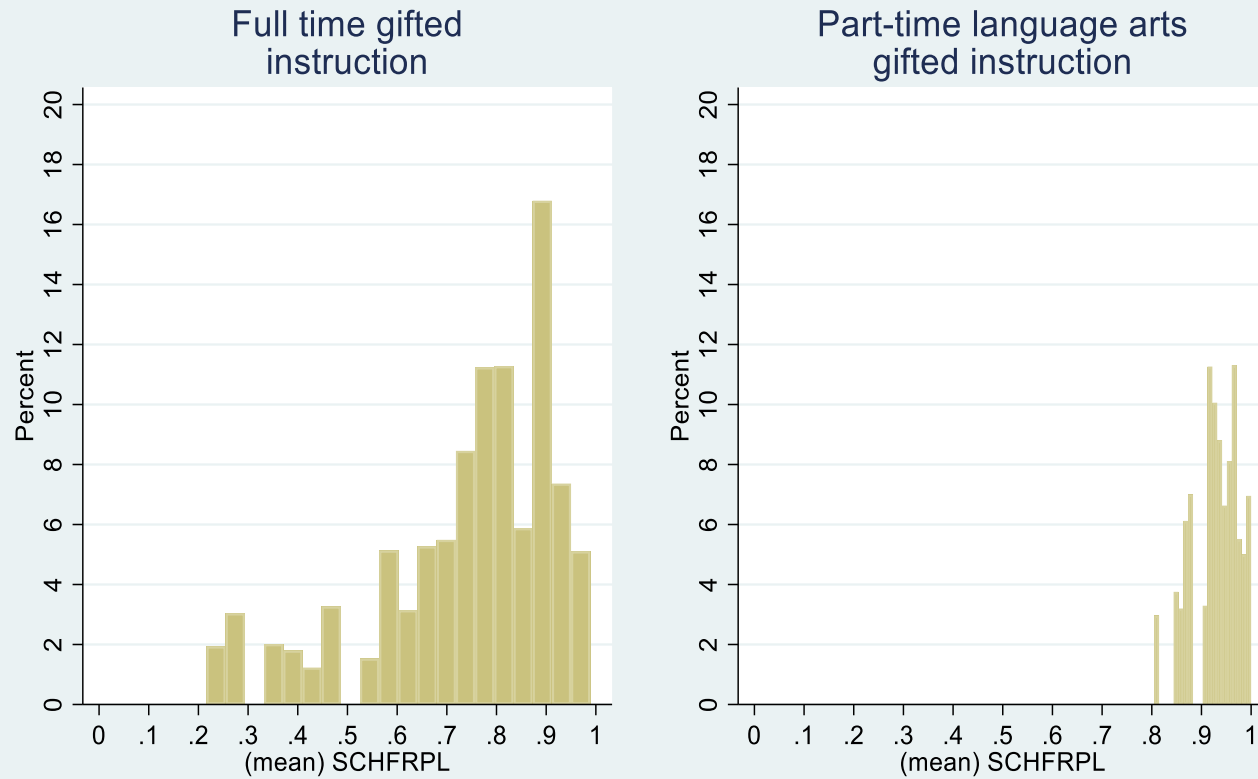
- Schools with part-time language arts gifted instruction have lower levels of math achievement (335) compared to full-time (340) and part-time math schools (339). The part-time LA schools have an effect size of .33 lower than full-time gifted schools in math achievement. Part-time LA schools also have an effect size of .27 lower than part-time math schools in math achievement.

Schools with part-time language arts gifted instruction have higher levels of student poverty compared to full-time and part-time math schools.

- Schools with Part-time gifted Mathematics instruction had lower levels of student poverty than full-time and part-time Language Arts Schools.

Distribution of School % FRPL

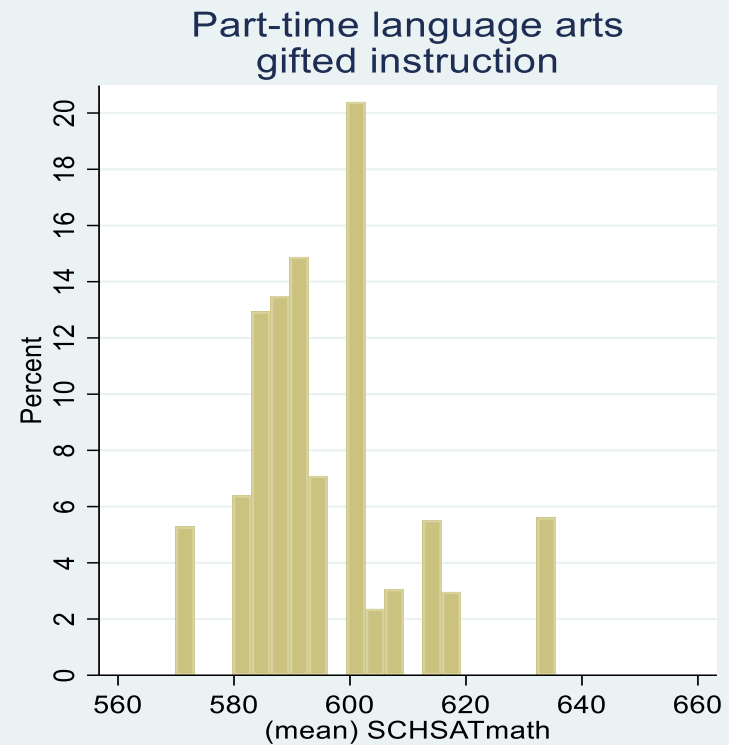
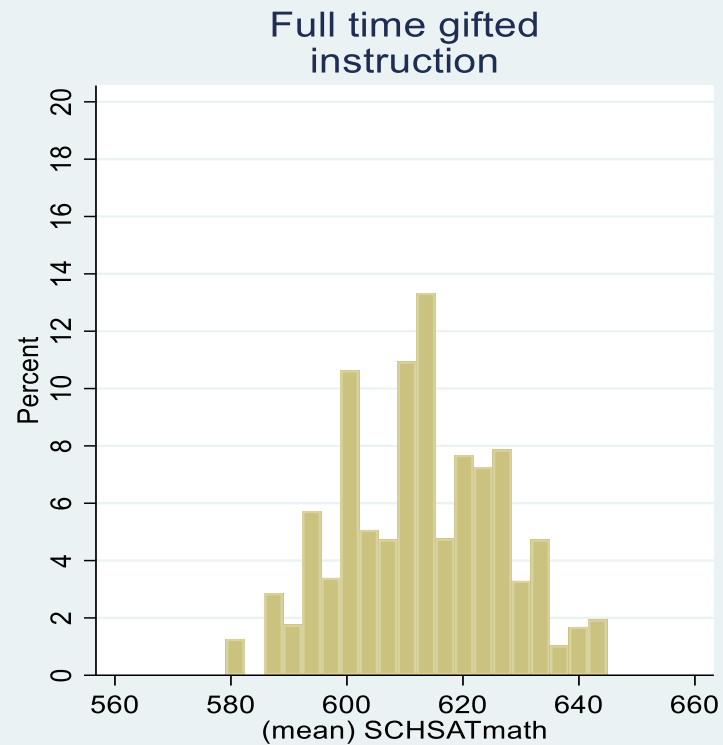
Distribution of School % FRPL
by Program for 4th grade 15/16



of bins=20 for each histogram

Distribution of Avg. 2nd Grade Math Achievement

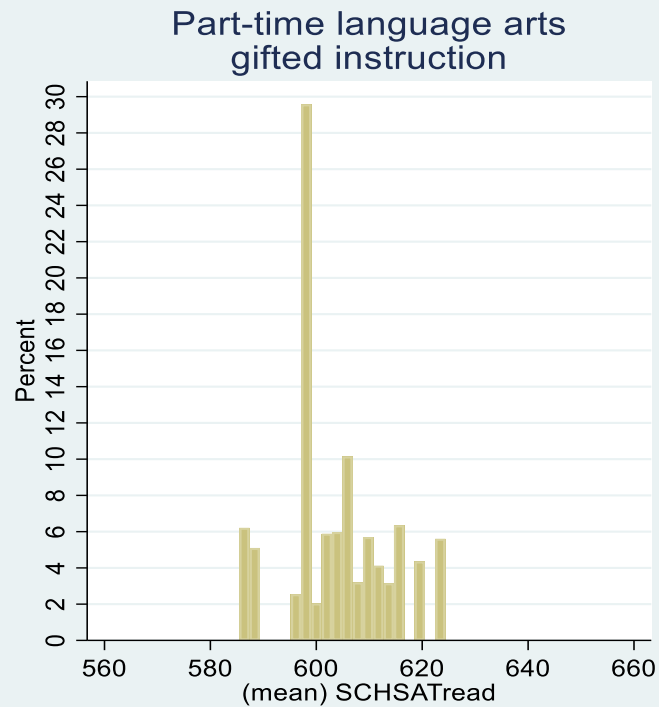
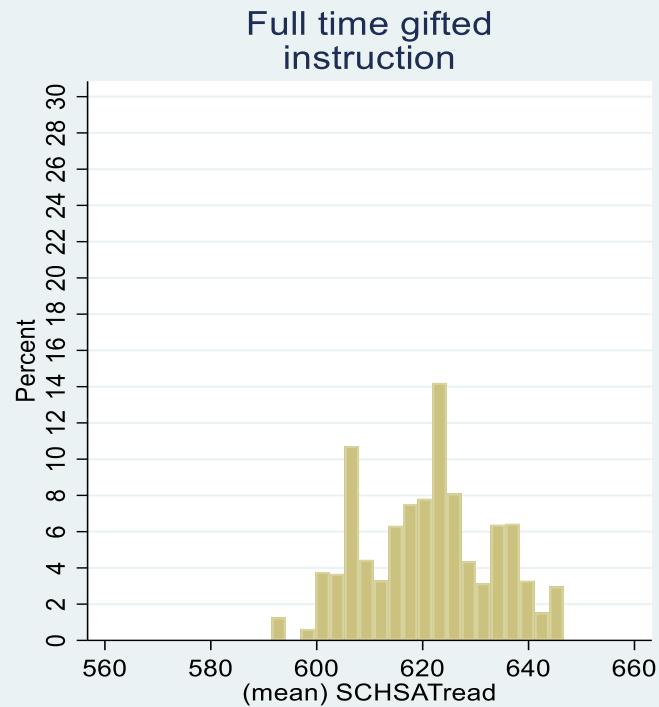
Distribution of School Avg. 2nd Grade Math Achievement by Program for 4th grade 15/16



of bins=20 for each histogram

Distribution of Avg. 2nd Grade RLA Achievement

Distribution of School Avg. 2nd Grade ELA Achievement by Program for 4th grade 15/16



of bins=20 for each histogram

Descriptive Statistics – For 16/17 5th grade cohort

Academic Achievement, School Poverty, and Student Poverty by type of Gifted Program, 4th & 5th grade

Figure 1:

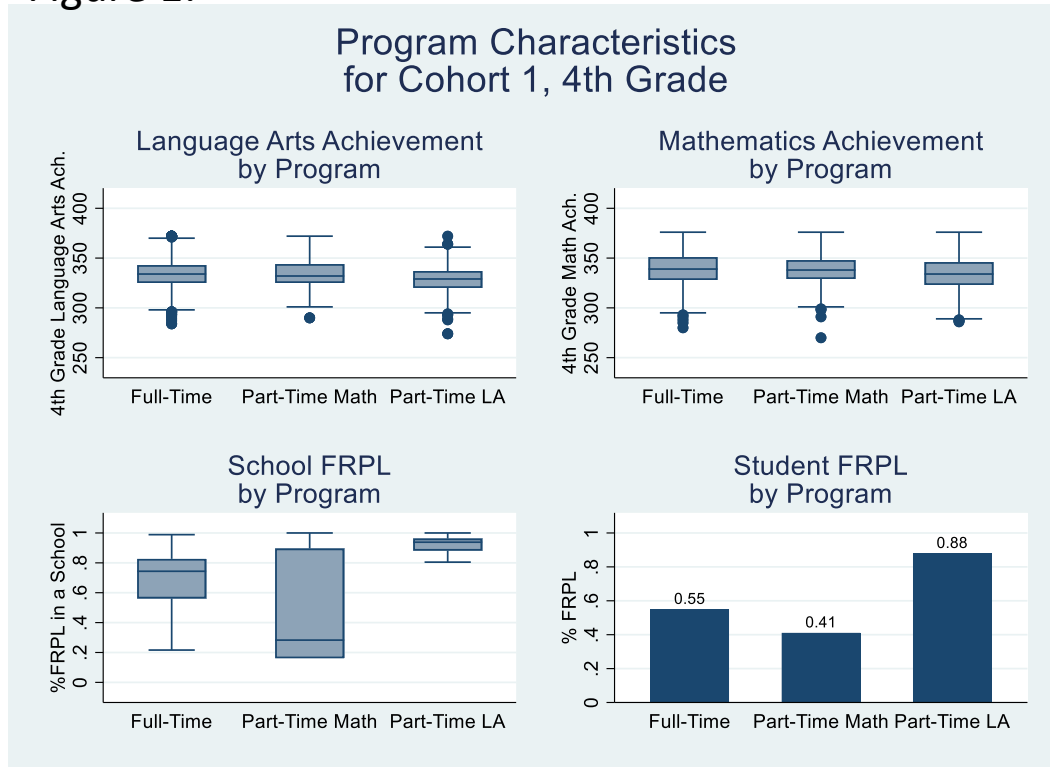
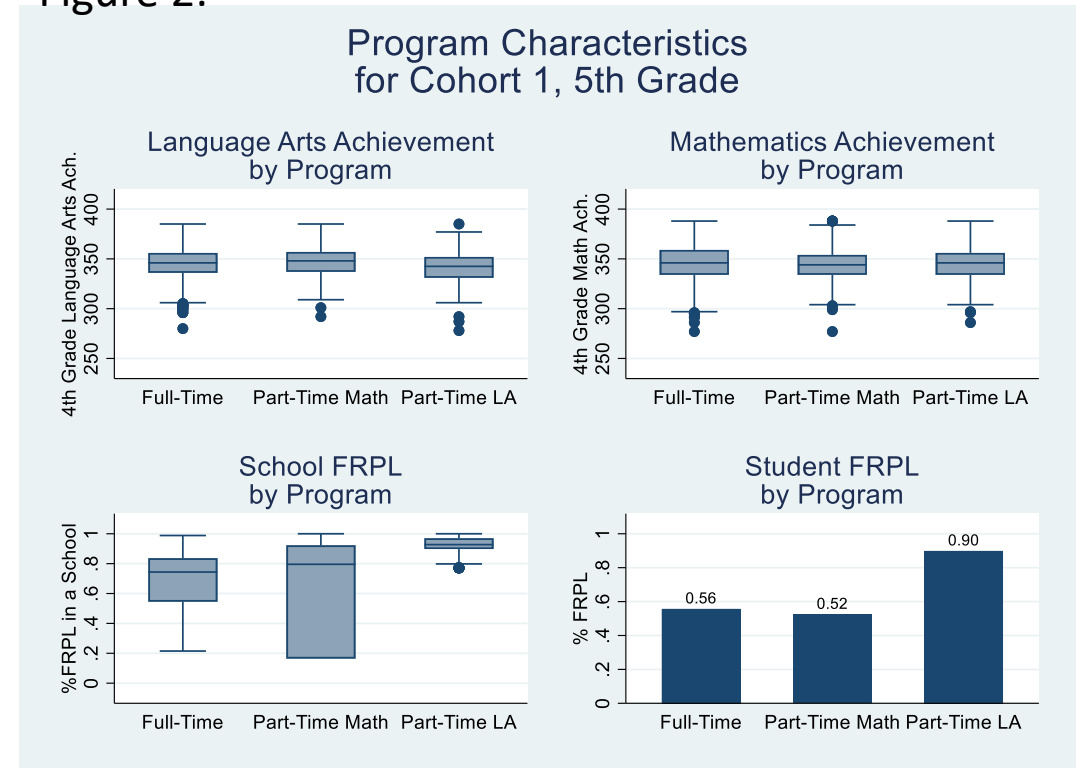


Figure 2:



Descriptive Statistics – For 17/18 5th grade cohort

Academic Achievement, School Poverty, and Student Poverty by type of Gifted Program, 4th & 5th grade

Figure 3:

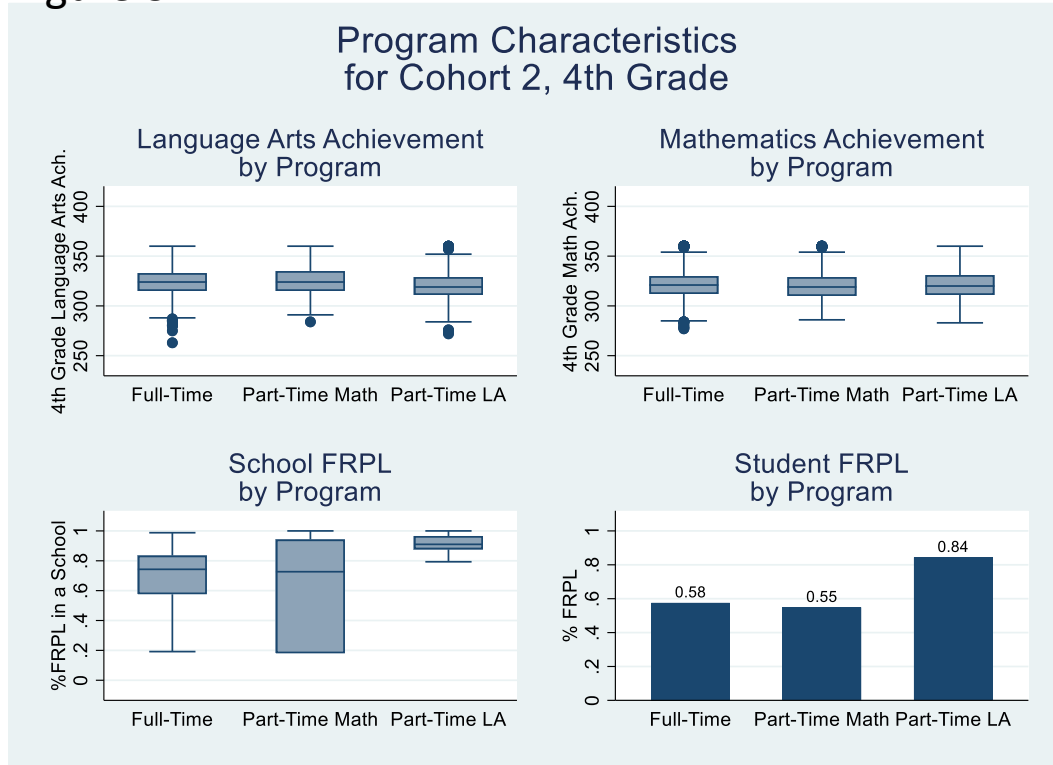
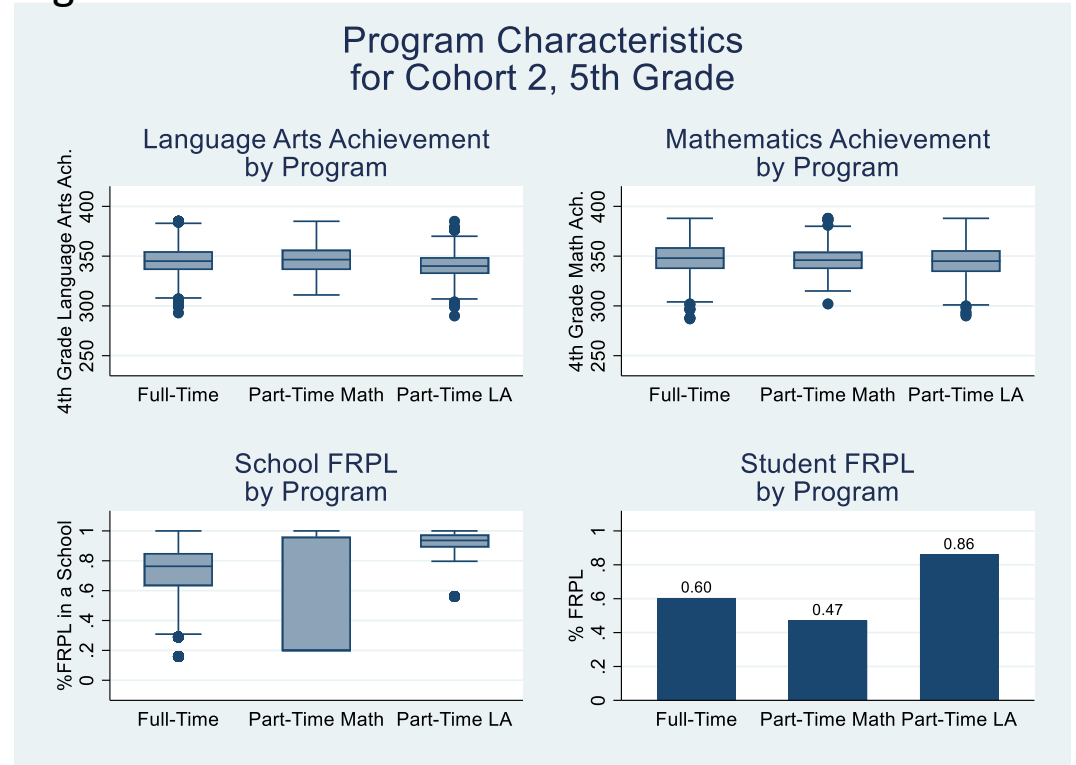


Figure 4:



Balance of Raw Unadjusted Sample for Full-Time Gifted Classes vs. Part-Time RLA Gifted Classes (i.e. Standardized Difference between Treatment and Control Groups)

Table 1:

Student Level Covariate	std.diff.
FRPL	-0.679*
Female	-0.024
black	-0.65*
hispanic	0.081
asian	0.149*
white	0.403*
other	0.042
ever_ELL	-0.217*
2 nd Grade RLA	0.285*
2 nd Grade Math	0.221*

School Level Covariates	Std. diff.
Gifted, proportion in school	1.052*
Black, prop. in school	-0.732*
FRPL prop. in school	-1.158*
female prop. in school	-0.05
Hispanic prop. in school	0.171
Asian prop. in school	0.695*
white prop. in school	0.753*
other prop. in school	0.025
Ever_ELL prop. in school	-0.517*
2 nd Grade, RLA, school avg.	1.448*
2 nd Grade, Math, school avg.	1.258*
Mean Standardized Difference (i.e. Balance)	0.51

Student N = 2303, School N = 111

Balance Comparisons

Table 2A: Mean Standardized Difference for Baseline,

Comparison	Outcome	Grade & Cohort	Raw Data/Baseline
Gifted Math (FT) vs. Regular Math (PT-LA)	Math	Grade 4 Cohort 1	0.51
		Grade 5 Cohort 1	0.5
		Grade 4 Cohort 2	0.49
		Grade 5 Cohort 2	0.55
Gifted Math (PT) vs. Regular Math (PT-LA)	Math	Grade 4 Cohort 1	0.63
		Grade 5 Cohort 1	0.5
		Grade 4 Cohort 2	0.52
		Grade 5 Cohort 2	0.63
Gifted LA (FT) vs. Regular LA (PT-M)	LA	Grade 4 Cohort 1	0.31
		Grade 5 Cohort 1	0.29
		Grade 4 Cohort 2	0.25
		Grade 5 Cohort 2	0.43
Gifted LA(PT) vs. Regular LA (PT-M)	LA	Grade 4 Cohort 1	0.63
		Grade 5 Cohort 1	0.51
		Grade 4 Cohort 2	0.52
		Grade 5 Cohort 2	0.63

Balance Comparisons

Table 2B: Sample Size for Baseline

Comparison	Outcome	Grade & Cohort	Raw Data/ Baseline	
			Students	Schools
Gifted Math (FT) vs. Regular Math (PT-LA)	Math	Grade 4 Cohort 1	2303	111
		Grade 5 Cohort 1	2291	111
		Grade 4 Cohort 2	2131	111
		Grade 5 Cohort 2	2252	111
Gifted Math (PT) vs. Regular Math (PT-LA)	Math	Grade 4 Cohort 1	566	41
		Grade 5 Cohort 1	578	44
		Grade 4 Cohort 2	576	44
		Grade 5 Cohort 2	482	44
Gifted LA (FT) vs. Regular LA (PT-M)	LA	Grade 4 Cohort 1	2247	92
		Grade 5 Cohort 1	2204	97
		Grade 4 Cohort 2	2076	97
		Grade 5 Cohort 2	2156	97
Gifted LA (PT) vs. Regular LA (PT-M)	LA	Grade 4 Cohort 1	569	41
		Grade 5 Cohort 1	560	44
		Grade 4 Cohort 2	577	44
		Grade 5 Cohort 2	482	44

Research Question

What is the effect of language arts and mathematics gifted classes on academic achievement of gifted students?

How well does optimal multilevel matching with network flows address selection in a clustered observational study?

Methods:

Six Different Approaches to Compare Treatment and Control Groups

1. OLS without covariates
2. OLS with covariates
3. Propensity Score weighting without covariates
4. Propensity Score weighting with covariates
For the propensity score matching the extreme values were trimmed and stabilized based on the methods in Harder, Stuart, & Anthony (2010).
5. Multi-level matching without covariates
6. Multi-level matching with covariates
Multilevel Matching based on the R package multi-match, which consists of a two-staged multilevel matching procedure (Pimentel, Page, & Keele 2018)

Methods:

Propensity Score Weighting

1. Calculated a propensity score with the following covariates:
 - Student Level:
FRPL, EL, Race/Ethnicity, 2nd grade math and reading/ELA achievement at the student level
 - School Level:
%gifted, %EL, % FRPL, % Black, % Hispanic, average 2nd grade math and reading/ELA scores at the school level
2. Used the propensity score to create an ATE inverse probability weight (IPW) for all observations
3. Extreme values were trimmed and stabilized based on the methods in Harder, Stuart, & Anthony (2010). We bottom-coded the IPTW at 0.1 and top-coded the IPTW at 10.
4. Estimated a weighted generalized linear model using propensity score weights as survey weights with the package svyglm in R

Methods:

Multi-Level Matching

1. We used the R-package multiMatch to do a two stage multi-level matching of first matching students then matching schools (Pimentel, Page, & Keele 2018).
2. We included the following variables for the student level matching:
FRPL, Black, Hispanic, 2nd grade math and reading/ELA achievement at the student level
3. For the school level matching, we used the following variables:
%gifted, % FRPL, % Black, % Hispanic, average 2nd grade math and reading/ELA scores at the school level.
4. MultiMatch uses fine balance at the school level which required converting all continuous variables into 6-category ordinal variables. We also gave priority to school percent FRPL and school percent gifted.
5. We set the tolerance to .1 for the matching.
6. After matching, we estimated a multilevel model using the lme package in R.

Results – Balance Comparisons

Comparison: Gifted Math(FT) vs. Regular Math

Outcome: Math

Balance measured with the mean standardized difference for of all covariates

Table 1: Mean Standardized Difference for Baseline, Propensity Score Weighting, and Multilevel Matching

	OLS	Propensity Score Weighting	Multilevel Matching
Grade 4 Cohort 1	0.51	0.37	0.17
Grade 5 Cohort 1	0.5	0.32	0.12

(Note: highlighted cells have adequate balance due to small differences between covariate means. We define an adequate balance as a mean standardized difference of less than .2)

Table 1B: Sample Size for Baseline, Propensity Score Weighting, and Multilevel Matching

	OLS		Propensity Score Weighting		Multilevel Matching	
	Students	Schools	Students	Schools	Students	Schools
Grade 4 Cohort 1	2303	111	2303	111	512	56
Grade 5 Cohort 1	2291	111	2291	111	468	52

Results – Balance Comparisons

Table 2A: Mean Standardized Difference for Baseline, Propensity Score Weighting, and Multilevel Matching

Comparison	Outcome	Grade & Cohort	Propensity Score		
			OLS	Weighting	Multilevel Matching
Gifted Math (FT) vs. Regular Math (PT-LA)	Math	Grade 4 Cohort 1	0.51	0.37	0.17
		Grade 5 Cohort 1	0.5	0.32	0.12
		Grade 4 Cohort 2	0.49	0.36	0.18
		Grade 5 Cohort 2	0.55	0.21	0.15
Gifted Math (PT) vs. Regular Math (PT-LA)	Math	Grade 4 Cohort 1	0.63	0.41	0.33
		Grade 5 Cohort 1	0.5	0.24	0.33
		Grade 4 Cohort 2	0.52	0.26	0.2
		Grade 5 Cohort 2	0.63	0.53	0.27
Gifted LA (FT) vs. Regular LA (PT-M)	LA	Grade 4 Cohort 1	0.31	0.35	0.16
		Grade 5 Cohort 1	0.29	0.38	0.19
		Grade 4 Cohort 2	0.25	0.31	0.33
		Grade 5 Cohort 2	0.43	0.36	0.54
Gifted LA(PT) vs. Regular LA (PT-M)	LA	Grade 4 Cohort 1	0.63	0.41	0.29
		Grade 5 Cohort 1	0.51	0.27	0.4
		Grade 4 Cohort 2	0.52	0.26	0.25
		Grade 5 Cohort 2	0.63	0.53	0.37

Results – Balance Comparisons

Table 2B: Sample Size for Baseline, Propensity Score Weighting, and Multilevel Matching

Comparison	Outcome	Grade & Cohort	OLS		Propensity Score Weighting		Multilevel Matching	
			Students	Schools	Students	Schools	Students	Schools
Gifted Math (FT) vs. Regular Math (PT-LA)	Math	Grade 4 Cohort 1	2303	111	2303	111	512	56
		Grade 5 Cohort 1	2291	111	2291	111	468	52
		Grade 4 Cohort 2	2131	111	2131	111	500	56
		Grade 5 Cohort 2	2252	111	2252	113	451	52
Gifted Math (PT) vs. Regular Math (PT-LA)	Math	Grade 4 Cohort 1	566	41	566	41	107	14
		Grade 5 Cohort 1	578	44	578	44	218	28
		Grade 4 Cohort 2	576	44	576	45	183	26
		Grade 5 Cohort 2	482	44	482	35	127	14
Gifted LA (FT) vs. Regular LA (PT-M)	LA	Grade 4 Cohort 1	2247	92	2247	92	419	22
		Grade 5 Cohort 1	2204	97	2204	97	424	30
		Grade 4 Cohort 2	2076	97	2076	94	238	26
		Grade 5 Cohort 2	2156	97	2156	94	119	14
Gifted LA (PT) vs. Regular LA (PT-M)	LA	Grade 4 Cohort 1	569	41	569	41	92	14
		Grade 5 Cohort 1	560	44	560	44	166	24
		Grade 4 Cohort 2	577	44	577	45	192	26
		Grade 5 Cohort 2	482	44	482	35	122	14

Results – OLS Analysis

Comparison: Gifted Math(FT) vs. Regular Math

Outcome: Math

Outcome	Cohort	Grade	Ordinary Least Squares Regression		Propensity Score Weighting		Multi-level Matching	
			No Covariates	With Covariates				
	1	4 th	0.30 *	0.02				
			[0.07]	[0.07]				
	1	5 th	0.16	-0.16				
			[0.07]	[0.07]				

Notes: *= p-value<=.01; Statistically significant coefficients are highlighted; Standard Error in Brackets; Covariates = FRPL Status; EL Status; Black, Hispanic, Asian, and other; 2nd grade math and reading/RLA achievement at the student level; and %gifted, %EL, % FRPL, % Black, % Hispanic, average 2nd grade math and reading/RLA scores at the school level; Standardized Coefficients

Results – Propensity Score Weighting

Comparison: Gifted Math(FT) vs. Regular Math

Outcome: Math

Cohort	Grade	Ordinary Least Squares Regression		Propensity Score Weighting		Multi-level Matching	
		No Covariates	With Covariates	No Covariates	With Covariates		
1	4 th	0.30 *	0.02	0.18	-0.01		
		[0.07]	[0.07]	[0.11]	[0.08]		
1	5 th	0.16	-0.16	-0.13	-0.22 *		
		[0.07]	[0.07]	[0.10]	[0.08]		

Notes: *= p-value<=.01; Statistically significant coefficients are highlighted; Standard Error in Brackets; Covariates = FRPL Status; EL Status; Black, Hispanic, Asian, and other; 2nd grade math and reading/RLA achievement at the student level; and %gifted, %EL, % FRPL, % Black, % Hispanic, average 2nd grade math and reading/RLA scores at the school level; Standardized Coefficients

Results – Multi-level Matching

Comparison: Gifted Math(FT) vs. Regular Math

Outcome: Math

Cohort	Grade	Ordinary Least Squares Regression		Propensity Score Weighting		Multi-level Matching	
		No Covariates	With Covariates	No Covariates	With Covariates	No Covariates	With Covariates
1	4 th	0.30 *	0.02	0.18	-0.01	-0.09	-0.14
		[0.07]	[0.07]	[0.11]	[0.08]	[0.14]	[0.15]
1	5 th	0.16	-0.16	-0.13	-0.22 *	-0.18	-0.26 *
		[0.07]	[0.07]	[0.10]	[0.08]	[0.10]	[0.10]

Notes: *= p-value<=.01; Statistically significant coefficients are highlighted; Standard Error in Brackets; Covariates = FRPL Status; EL Status; Black, Hispanic, Asian, and other; 2nd grade math and reading/RLA achievement at the student level; and %gifted, %EL, % FRPL, % Black, % Hispanic, average 2nd grade math and reading/RLA scores at the school level; Standardized Coefficients

Results: Gifted Math (Full-Time) vs. Regular Math

Comparison: Gifted Math (FT) vs. Regular Math (in schools with part time gifted LA classes)
Outcome: Math

Table 3:

Comparison	Cohort	Grade	Ordinary Least Squares Regression		Propensity Score Weighting		Multi-level Matching	
			No Covariates	With Covariates	No Covariates	With Covariates	No Covariates	With Covariates
Gifted Math (Full-Time) vs. Reg. Math	1	4 th	0.30 *	0.02	0.18	-0.01	-0.09	-0.14
			[0.07]	[0.07]	[0.11]	[0.08]	[0.14]	[0.15]
	1	5 th	0.16	-0.16	-0.13	-0.22 *	-0.18	-0.26 *
			[0.07]	[0.07]	[0.10]	[0.08]	[0.10]	[0.10]
	2	4 th	0.22 *	-0.14	-0.03	-0.14	-0.2	-0.22
			[0.07]	[0.07]	[0.09]	[0.09]	[0.13]	[0.14]
	2	5 th	0.29 *	-0.09	-0.01	0.04	0.09	0.03
			[0.08]	[0.08]	[0.2]	[0.15]	[0.16]	[0.15]

Notes: *= p-value<=.01; Statistically significant coefficients are highlighted; Standard Error in Brackets; Standardized Coef.

Key Findings:

- No Positive Statistically Significant Effect of Math Instruction with OLS with covariates, propensity score weighting or multi-level matching models
- Cohort 2 can be viewed as a replication of cohort 1 and we find little consistency between the 4th and 5th grade cohort 1 statistically significant results and the 4th and 5th grade statistically significant results

Results: Gifted Math (Part-Time) vs. Regular Math

Comparison: Gifted Math (PT) vs. Regular Math (in schools with part time gifted LA classes)

Table 4:

Outcome: Math

Comparison	Cohort	Grade	Ordinary Least Squares Regression		Propensity Score Weighting		Multi-level Matching	
			No Covariates	With Covariates	No Covariates	With Covariates	No Covariates	With Covariates
Gifted Math (Part-Time) vs. Reg. Math	1	4 th	0.16	-0.19	0.09	-0.16	-0.2	-0.24
			[0.06]	[0.08]	[0.08]	[0.07]	[0.21]	[0.28]
	1	5 th	0.02	-0.06	-0.08	-0.13	0	0.06
			[0.06]	[0.08]	[0.1]	[0.09]	[0.15]	[0.13]
	2	4 th	0.08	0.06	0.05	0.06	0.16	0.27
			[0.07]	[0.07]	[0.09]	[0.07]	[0.16]	[0.15]
	2	5 th	0.05	0.16	0.07	0.1	0.14	0.08
			[0.08]	[0.11]	[0.09]	[0.12]	[0.14]	[0.19]

Notes: *= p-value<=.01; Statistically significant coefficients are highlighted; Standard Error in Brackets; Standardize Coef.

Key Findings:

- No positive and statistically significant effects of gifted Math instruction with OLS, propensity score weighting or multi-level matching models
- Cohort 2 can be viewed as a replication of cohort 1, we find consistent results for cohorts 1 and 2

Results: Gifted LA (Full-Time) vs. Regular LA

Comparison: Gifted LA (FT) vs. Regular LA (in schools with part time gifted Math classes)

Table 5:

Outcome: Language Arts

Comparison	Cohort	Grade	Ordinary Least Squares Regression		Propensity Score Weighting		Multi-level Matching	
			No Covariates	With Covariates	No Covariates	With Covariates	No Covariates	With Covariates
Gifted LA (Full-Time) vs. Reg. LA	1	4 th	0.01	0.03	0.28	0.05	0.15	0.2
			[0.07]	[0.06]	[0.11]	[0.08]	[0.13]	[0.14]
	1	5 th	-0.01	-0.16	0.31	0.04	-0.04	0
			[0.07]	[0.07]	[0.14]	[0.1]	[0.13]	[0.11]
	2	4 th	0.09	0.06	0.14	0.14	-0.19	-0.29
			[0.07]	[0.07]	[0.12]	[0.09]	[0.12]	[0.13]
	2	5 th	-0.13	-0.18	-0.22	-0.08	-0.05	-0.39
			[0.08]	[0.09]	[0.36]	[0.28]	[0.27]	[0.6]

Notes: *= p-value<=.01; Statistically significant coefficients are highlighted; Standard Error in Brackets; Standardized Coef.

Key Findings:

- No Positive Statistically Significant Effect of Gifted Language Arts Instruction with OLS, propensity score weighting or multi-level matching models
- Findings from cohort 2 are consistent with findings from cohort 1

Results: Gifted LA (Part-Time) vs. Regular LA

Comparison: Gifted LA (PT) vs. Regular LA (in schools with part time gifted Math classes)

Table 5:

Outcome: Language Arts

Comparison	Cohort	Grade	Ordinary Least Squares Regression		Propensity Score Weighting		Multi-level Matching	
			No Covariates	With Covariates	No Covariates	With Covariates	No Covariates	With Covariates
Gifted LA (Part-Time) vs. Reg. LA	1	4 th	-0.22*	-0.01	-0.17	-0.02	-0.08	0.19
			[0.06]	[0.07]	[0.07]	[0.07]	[0.14]	[0.15]
	1	5 th	-0.22*	-0.01	-0.08	0.01	0.1	-0.02
			[0.07]	[0.07]	[0.08]	[0.08]	[0.12]	[0.17]
	2	4 th	-0.23 *	0.01	-0.09	-0.02	0.02	0.07
			[0.07]	[0.08]	[0.09]	[0.08]	[0.14]	[0.13]
	2	5 th	0.41*	-0.34 *	-0.49 *	-0.44*	-0.34	-0.26
			[0.08]	[0.12]	[0.09]	[0.12]	[0.2]	[0.39]

Notes: * = p-value ≤ .01; statistically significant coefficients are highlighted; Standard Error in Brackets; Standardized Coef.

Key Findings:

- No Positive Effect of Gifted Language Arts Instruction with OLS, propensity score weighting or multi-level matching models
- Limited consistency between the 4th and 5th grade cohort 1 statistically significant results and the 4th and 5th grade statistically significant results

Sensitivity Tests

1. A Comparison of Matching Strategies
2. Comparison of Strategies used to identify school level variables used with fine balance
3. The impact of prioritization with skewed and balanced covariates

Comparison of Matching Strategies for the Full-time Gifted vs. Part-time Language Arts Comparison

Matching Strategy	Mean Standardized Difference	Student N	School N
Match School only	.45	1082	60
Match School and Students	.39	605	60
Match School and Students with fine balance without prioritizing	.29	279	22
Match School and Students with fine balance and prioritizing %FRPL and % gifted at the school level	.17	512	56

Comparison of Different Sets of Covariates Used for Fine Balance

for the Full-time Gifted vs. Part-time Language Arts Comparison

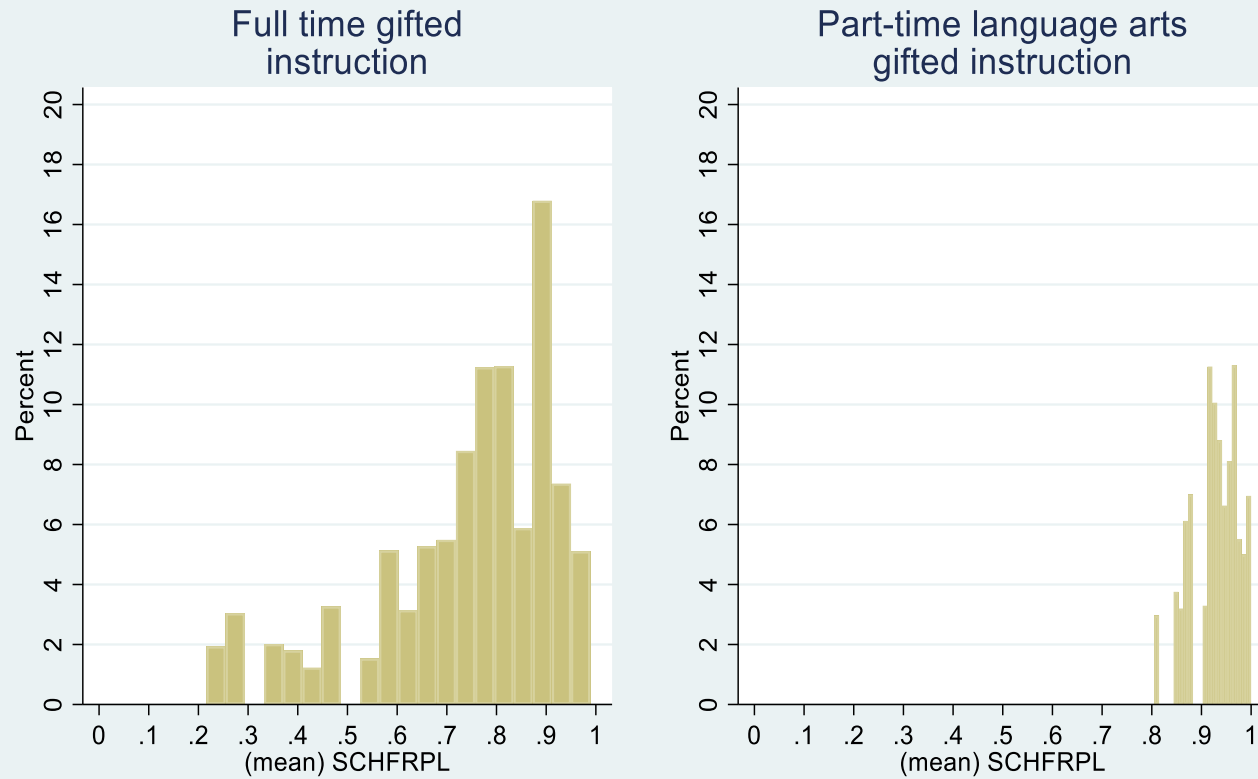
Covariates Used for Fine Balance	MSD	Student N	School N
Raw Standardized Diff. $\geq .7$ (% FRPL school mean, 2nd grade Math and ELA mean, % gifted school mean, % black & % white school mean; Prioritizing % FRPL then % gifted)	.23	539	60
Raw Standardized Diff. ≥ 1.1 (% FRPL school mean, 2 nd grade Math and ELA school mean; Prioritizing % FRPL)	.19	489	56
All School Level Covariates (Prioritizing % FRPL then % gifted)	.18	489	56
Theoretically informed subset of variables (FRL, Black, Latino, and 2 nd grade ach. At the school and student level plus % gifted at school level ; Prioritizing % FRPL then % gifted)	.17	512	56

Comparison of Different Variables Used for Prioritization for the Full-time Gifted vs. Part-time Language Arts Comparison

Prioritization Variable	Mean Standardized Difference	Student N	School N	RLA School Avg. Std. Diff.	Math School Avg. Std. Diff.	% FRL School Avg. Std. Diff.	% Gifted School Avg. Std. Diff.
Prioritizing %FRPL and % gifted at the school level	.17	512	56	.556*	.304*	-.572*	.020
Prioritizing school avg. RLA and avg. Math	.14	363	38	.106	.029	-.668*	.112
Prioritizing %FRPL	.17	512	56	.556*	.304*	-.572*	.228
Prioritizing % Gifted	.24	550	60	.704*	.491*	-.765*	.041
Raw Data for Reference:	.51	2303	111	1.448*	1.258*	-1.158*	1.052*

Distribution of School % FRPL

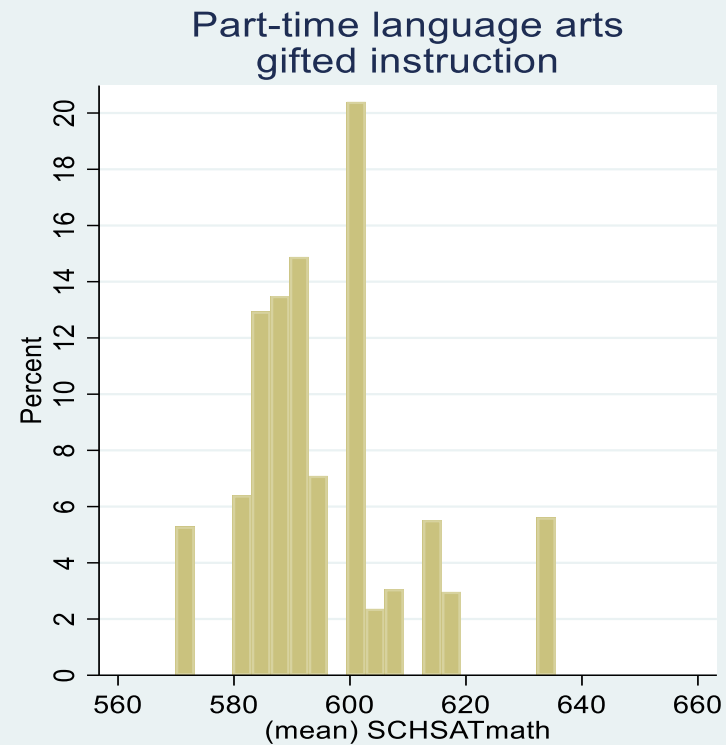
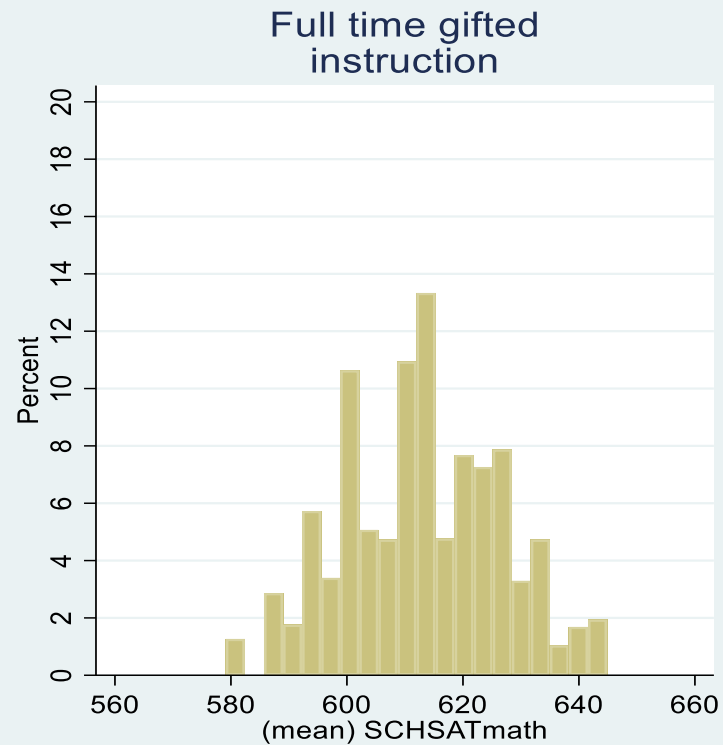
Distribution of School % FRPL
by Program for 4th grade 15/16



of bins=20 for each histogram

Distribution of Avg. 2nd Grade Math Achievement

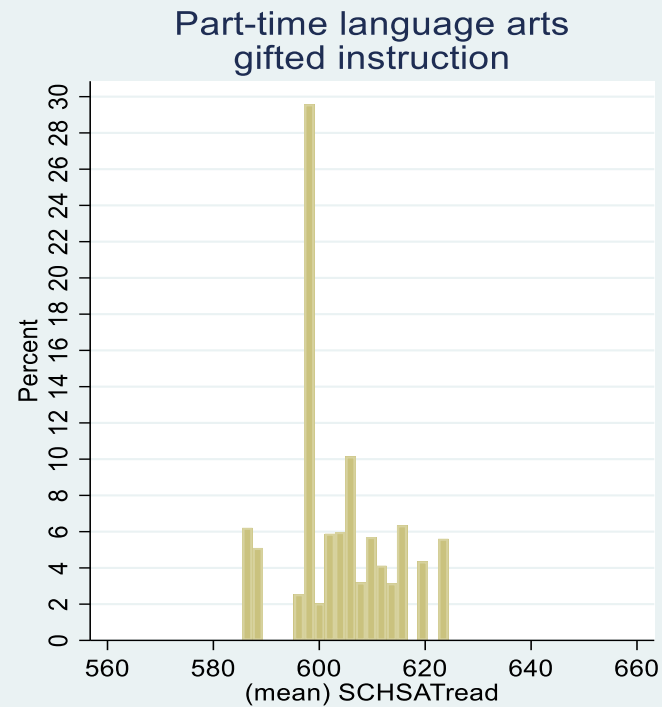
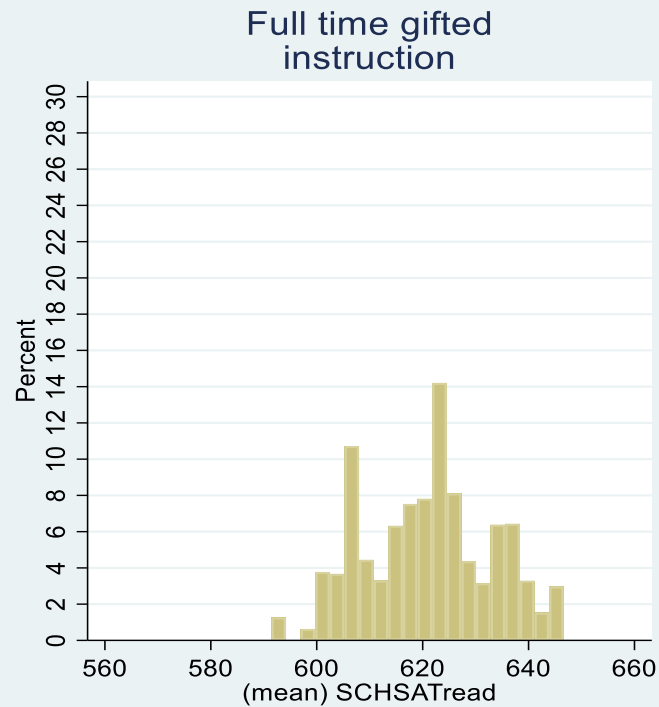
Distribution of School Avg. 2nd Grade Math Achievement by Program for 4th grade 15/16



of bins=20 for each histogram

Distribution of Avg. 2nd Grade RLA Achievement

Distribution of School Avg. 2nd Grade ELA Achievement by Program for 4th grade 15/16



of bins=20 for each histogram

Conclusion

- No Effect of Gifted RLA or Gifted Math Classes on Academic Achievement. Multiple methods found no effect:
 - Simple OLS with Covariates
 - Propensity Score Weighting
 - Multilevel Optimal Matching
- In our case of highly unbalanced data, Multilevel Optimal Matching was able to identify more balanced sample compared to the balance achieved with propensity score weighting in 13 out of 16 comparisons.
- Half of the matched samples had a balance less than .2. However, balance was obtained by substantially decreasing the sample size.
- Sensitivity tests (with one comparison) find:
 - Multilevel Optimal Matching required the use of both fine balance and prioritizing school level covariates to obtain a balance less than .2
 - Theoretically Informed Selection of covariates performed better than covariates for fine balance selected only by level of mean standardized difference
 - Symmetric distributions balance better than highly skewed distributions