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The urban advantage: The impact of informal science collaborations on student achievement

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REPORT
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ABSTRACT

This study reports findings from an evaluation of New York City's Urban Advantage (UA) program, a collaboration between the New York City Department of Education and eight informal science education institutions intended to improve science education in middle schools. We investigate whether UA has led to increases in students' science achievement in New York City public schools. Using a unique teacher-student linkage data from school years 2012-13 to 2015-16 we find that having a UA teacher increases student performance on New York State's standardized eighth-grade science exam by 0.07 standard deviations (an increase from the 62nd to 64th percentile). Moreover, we find evidence that students also benefit from being taught by a teacher who was ever in UA, even if the teacher is not currently participating in UA. As informal partnerships between schools and external institutions become more common, evaluations such as those in this study can be used to guide changes in program implementation and education policy.

I. Introduction

In 2008, the American Museum of Natural History contacted researchers at New York University's Institute for Education & Social Policy to conduct an initial evaluation of the Urban Advantage program, which at that point was barely four years old. Urban Advantage (UA) is a formal-informal partnership that began in the 2004-05 school year (hereafter 2005) after meetings between New York City's (NYC) science institutions, the Department of Education, and the City Council to discuss how to support middle school science teachers with a recently-introduced eight-grade science "exit project" requirement in the city. UA brings together the resources of NYC's informal science education institutions (ISEIs) and the NYC public school system to improve instruction in middle school science. UA provides intensive professional development for participating teachers, materials for science classrooms, and free access to ISEIs for class trips and independent visits. Now in its 14th year of operation, the UA program has grown and become embedded in NYC's approach to science instruction. In the latest year of our current analysis, 2016, roughly half of NYC middle schools were actively participating in UA and close to 60% had ever participated in UA.

Given the data that was available in 2008, our analysis focused on the impact of the UA program on student achievement at the school-level (Weinstein & Ruble, 2011). We found that UA schools, on average, perform 0.04 - 0.06 standard deviations higher than non-UA schools on the New York State (NYS) 8th grade Intermediate Level Science (ILS) exam.

Our second study used more nuanced, student-level data and found that attending a UA school increases students' performance on the ILS exam by approximately 0.05 standard deviations, with larger effects for students who are black, in special education, or male (Weinstein et al., 2014). We also found small positive effects on the likelihood that a student

takes a science Regents exam (NYS high school exit exam) in the eighth or ninth grade, but no consistent effect of UA on the probability of scoring proficient on the exam. Finally, we did not find any systematic effect of attending a UA school in the 8th grade on a student's likelihood of attending a science, technology, engineering, and math (STEM) high school. However, because of data limitations, the analyses above used a conservative definition of the treatment – attending a school that has ever had a UA teacher. Because this definition conflates both students who were and were not actually taught by a UA teacher, it biased our estimates toward zero and likely underestimated the true program effect.

In this current study, we capitalize on the availability of unique student-teacher linkage data that allow us to identify students taught by a UA teacher, in other words, those students actually receiving the treatment. Moreover, we use the student's course information to correctly identify science classes and the corresponding science teacher. Thus, we are able to more precisely estimate whether being taught by a UA teacher for science improves achievement in 8th grade science. This study also adds one additional year of analysis, the school year 2015- 2016. We identify the comparison group as students with teachers who are not participating in UA in that year. Moreover, we conduct robustness checks and strengthen our identification strategy by using propensity score matching (PSM) to obtain a matched set of treatment and control schools that have the same propensity to participate in UA.

Results reveal that UA was successful in improving students' performance in science. In models comparing students with and without a UA teacher in the same school, we find that the program increases scores on the 8th grade ILS exam by 0.070 standard deviations, or put differently moves participating students from the 62nd to the 64th percentile of the distribution.

Students with UA teachers are also 3.4 percentage points more likely to score proficient (levels 4 and 4) on the ILS exam. All of our results are robust to the PSM models.

The remainder of this paper is organized as follows. Section II describes the data and presents descriptive statistics. Section III describes our methodology. We present findings in section IV and conclude with implications and future work in section V.

II. Data

We use detailed student-, teacher-, and course-level data provided by the NYC Department of Education (NYCDOE), from school years 2013-2016. These data include teacher-student linkage files, student demographics and educational files, teacher personnel files, and a UA teacher file that identifies teachers participating in UA and their participating school. The teacher-student linkage files identifies students' science courses and teachers. The student level files include socio-demographic characteristics (age, gender, race/ethnicity, birthplace), educational needs (special education, limited English proficiency, eligibility for free/reduced price lunch), and standardized test scores (statewide English, math, and science exams in grades 3-8). The teacher personnel data contain identifiers for race/ethnicity, gender, job title, licensing, subject(s) taught, salary, absences, teaching experience, and tenure with the NYCDOE. All of the data have a unique person and school identifier that allow us to track individual students across schools and over time.[1] All analyses exclude charter schools and special education only schools (District 75 in NYC).[2] We also exclude teachers and schools with less than 10 students who took the 8th grade ILS exam (the outcome). Our final analytical sample includes 222,833 unique

[1] All student and teacher files are de-identified since NYCDOE provided us with scrambled identification numbers.
[2] Charter schools are excluded because we do not have student-teacher linkage data for these schools.

students (223,775 observations) in 514 schools who took the 8th grade ILS exam, all linked to their science teacher and his/her characteristics, from school years 2013-2016.

Our outcome, science achievement, is measured using the 8th grade ILS exam. The analytic sample contains 8th grade students who took this exam and who could be matched to a teacher. These students are matched to the student-teacher linkage data and course data so that every student is linked with their science teacher in each academic year. Thus, we are able to identify students that have a UA teacher and those who do not both across and within schools. Table 1 shows that approximately 40% of all students who took the ILS exam (our sample) are enrolled at a UA school. Of these, over half are taught by a UA teacher. In general, 54.9% of the science teaching staff at a UA school are UA teachers. Table 2 presents the percentage of science teachers and students we were able to match using the data from NYCDOE. Our analysis includes a total of 514 schools that enroll 8th grade students over the four year period. Of these, 41.2% are identified as a UA school.[3] Of the 784 active UA teachers during 2013 through 2016 school years (in all NYC public schools), we were able to match close to 60% of them to students who have 8th grade ILS scores.

Table 3 presents descriptive statistics on the student sample. The demographic landscape of this sample of 8th grade ILS exam takers is typical of the NYC public schools. For example, there is a relatively even split between boys and girls, roughly 40% of students are Hispanic, and the majority (76%) are eligible for free/reduced price lunch. Roughly 33% of students have at some point had a science teacher who participated in UA. In terms of performance, 54% of

[3] A school is UA if there is at least one active UA teacher in that year.

students scored in level 3 or 4 (proficient) on the 8th grade ILS exam and the average z-score for the sample is 0.013 standard deviations above than the citywide average.[4]

III. Methodology

Participation in the UA program is not random and could depend on the teacher and school-level characteristics. To participate in UA, principals must first apply for their school to participate. Once the school is accepted into the UA program, individual teachers decide whether or not to participate. All 6th, 7th, or 8th grade teachers are eligible, regardless of the grade configuration of the school. While most participating teachers teach science, there are a number of teachers who teach other subjects or specific populations, in particular, special education and bilingual education. Participating schools run the gamut from high performing to low performing and low poverty to high poverty schools. While principal buy-in starts the process, reasons why individual teachers choose to participate vary. Teaching experience, student achievement, and demographics can predict participation. Thus, it is important to adjust for the selection of schools and teachers into the UA program. Our methodology is described below.

Our outcome of interest is the 8th grade ILS exam and we examine the z-score obtained, the probability of meeting the proficiency standards (scoring in levels 3 or 4), and the scoring percentile. We estimate the relationship between science achievement and two treatments: the first is having a teacher who participated in UA in the current year, and second, having a teacher who ever participated in UA (excluding active UA teachers). Specifically, we estimate model (1):

$$Y_{its} = \beta_0 + \delta UATeach_{it} + \boldsymbol{I}'_{\boldsymbol{it}}\boldsymbol{\beta_1} + \boldsymbol{Z}'_{zt}\boldsymbol{\beta_2} + \alpha_s + \tau_t + \varepsilon_{its} \qquad (1)$$

[4] We measure student performance on the ILS exam with a standardized score ("z-score"), a measure of relative performance standardized across students within a grade to have mean 0 and standard deviation 1. Students performing above (below) average relative to other students in their grade have positive (negative) z-scores.

where *Y* is the outcome of interest (z-score, meeting the standard, or percentile) for student *i*, in year *t*, in school *s*; *UATeach* is equal to 1 if a student has a UA teacher and 0 if not; α_s and τ_t are school and year fixed effects, respectively; *I* is a vector of *time-varying* student characteristics while *Z* is a vector of *time-varying* teacher characteristics (total NYCDOE years and years in UA); ε_{it} is the error term with the usual properties. Robust standard errors clustered by the teacher are included. This school fixed effects model allows us to compare the performance of students with and without a UA teacher within the same school, and thus adjust for differences across schools in their likelihood to participate in the program and other school-level confounders that can influence student performance.

For robustness, we use propensity score matching to get a comparable group of treatment and control schools with the same propensity to participate in UA. We match on the following school-level observable characteristics that can influence a school's decision to participate in UA and how effective their teachers are with students: teaching experience, average student achievement, spending, teacher engagement, class size, and demographic composition.[5] We have strong common support (see Appendix Figure A1) and achieve balance across treatment and control schools (see Appendix Table A1).[6,7] The models for the PSM robustness checks are the same except including a matched school pair fixed effect so that comparisons are made between

[5] Specifically, we use the following school level measures: student math and science proficiency, student attendance, teachers without a certificate, teachers with less than three years of teacher experience, per pupil spending, teacher absences, school size, teacher pupil ratio, race/ethnicity, English language learners, immigrant, students with disabilities, free/reduced lunch eligible students.

[6] Common support ensures that there is sufficient overlap in the characteristics of control and treatment schools to find adequate matches. Appendix figure A1 illustrates that there is strong common support.

[7] Appendix table A1 presents results from a covariate balance test (a standard check for successful matching) in which the treatment, ever UA school, is regressed on several covariates to test that these confounders are not statistically different between the matched treatment and control groups.

matched schools that have the same likelihood of participating in UA.[8]

IV. Findings

In Table 4 we estimate equation 1, on 8th grade ILS z-scores, successively adding in controls. Our variable of interest is whether a student has a UA teacher in the current year. In Model 1 we control for student characteristics (demographics and educational programs), while in models 2 and 3 we control for teacher experience. Our preferred specification Model 3 contains school fixed effects so we can capture the difference between students with UA teachers and those without in the same school. Corresponding models in percentiles are presented in Table 5 columns (4) through (6).

In Table 4 models 1 and 2 we see that there is no statistically significant difference between students who do and do not have a UA teacher in the year they take the 8th grade ILS exam. Model 1 only adjust for students' demographic characteristics and model 2 additionally adjusts for years of teaching experience. These two models, however, do not adjust for differences in the quality and type of schools students attend and estimates are potentially biased if school characteristics influence student performance and UA participation. In Model 3 we adjust for all fixed observable and non-observable school factors that may be confounding the relationship between having a UA teacher and science achievement by add school fixed-effects. We see that students with UA teachers outperform their peers in the same school who do not have a UA teacher by 0.070 standard deviations. Put differently, students without a UA teacher score at the 62nd percentile compared to peers who have a UA teacher who score in the 64th percentile.

[8] This PSM analysis also alleviates concerns from the school fixed effects models that there may not be enough UA and non-UA teachers in the same school to do a within school comparison, as well as concerns that some schools do not have any UA teachers.

Table 5 also presents results from estimating a linear probability model[9] of the impact of having a UA teacher on the probability of meeting proficiency standards (scoring in level 3 or level 4). We see again that in the fully specified Model 3, which compares students within the same school, students with a UA teacher are 3.4 percentage points more likely to score in levels 3 or 4 compared to their classmates who did not have a UA teacher. Therefore, from an average of 54% of students meeting the standard (see Table 3), 57% of students with a UA teacher will meet the standard.

Do former UA teachers carry the benefits with them after they leave UA? Table 6 suggests that they do. In Table 6, we differentiate between students who currently have a UA teacher and those who were previously in UA. While teachers who have participated in UA previously are still able to use the UA teaching practices in their classroom, they do not have access to the other benefits that are available to active teachers, including funds for classroom supplies and vouchers for trips to the museums, gardens, and zoos. We find, however, students who have a teacher that ever participated in UA still outperform those who did not. In our preferred specification in column (3), the positive impact of having a teacher who ever participated in UA on the ILS exam is 0.064sd, and on proficiency is 2.5 percentage points. Both of these estimates are smaller than the impact of having a current teacher but are nonetheless meaningful.

Robustness tables 9 and 10 replicate the analysis above using a matched set of schools with the same propensity to participate in UA. All results are comparable to our preferred specifications in Tables 4-6. Some PSM estimates are slightly attenuated while others are slightly stronger. Taken together, all results indicate that UA consistently improves students'

[9] We estimate a linear probability model, as opposed to logit or probit, for ease of interpretation and because it has better consistency properties with fixed effects.

performance in 8th grade science, both in terms of z-scores and the likelihood of scoring proficient. Improvements in percentiles, however, do not hold.

V. Conclusion

The UA program is a unique formal-informal partnership made possible through an ongoing collaboration between the AMNH, UA staff, eight cultural institutions, and the NYCDOE. UA has attracted the attention of school districts and cultural institution in other cities, some of which have undertaken feasibility studies, including Denver and Kansas City who have launched their own UA program. The Denver Museum of Nature and Science, for example, launched a UA program in 2010. Despite the growing number of collaborations between schools and external institutions, there is relatively little research on the impact of such partnerships. As a long-standing partnership program, evidence from UA has implications not only for improving science teaching but also more generally for creating strong partnerships between school districts and external institutions. Using newly available teacher-student linkage and course data, we evaluate the impact of NYC's UA program on students' science achievement. We find evidence that UA improves performance on standardized 8th grade science exams. Our analyses suggest that students within the same school may not be receiving the same science education and UA students are benefiting from UA resources and teachers who have experienced UA professional development.

In future work, we will evaluate the impact of having a UA teacher in earlier grades (6th or 7th) and in multiple grades (for example, in both 7th and 8th grades). We will also conduct subgroup analyses to see whether the impact of having a UA teacher varies by gender, race/ethnicity, and disability or English learner status. Lastly, recognizing that the UA model promotes collaboration between teachers and school administrators, which can improve the work

environment, we will use the NYC Learning Environment Survey to explore student and teacher perceptions of their school environment.

References

Weinstein, M. & E. Ruble (2011). "Can Formal–Informal Collaborations Improve Science Literacy in Urban Middle Schools? The Impact of Urban Advantage," IESP Policy Brief 5-11 (June). New York: NYU Institute for Education & Social Policy

Weinstein, M., Whitesell, E. R., & Schwartz, A. E. (2014). Museums, zoos, and gardens: How formal-informal partnerships can impact urban students' performance in science. *Evaluation review*, *38*(6), 514-545.

Tables and Figures

Table 1. Students in the analytic sample

	(1)	(2)		(3)		(4)
	Total Students	Students Enrolled in UA Schools		Students Taught by UA Teacher in UA School		Teachers Who Are UA in UA school
	N	N	%	N	%	%
2013	59,736	19,179	*32.1*	11,471	*59.8*	*58.0*
2014	59,631	25,202	*42.3*	14,036	*55.7*	*55.4*
2015	54,584	27,427	*50.2*	15,041	*54.8*	*54.8*
2016	49,824	21,259	*42.7*	12,603	*59.3*	*50.2*
Total:	223,775	93,067	*41.6*	53,151	*57.1*	*54.9*

Notes: Column (1) is the total number of students in the analytic sample each year. Column (2) is the number of students who are enrolled in a UA school and the correspond percentage as a share of the total number of students. Column (3) is the number of students in UA schools taught by a UA teacher and the corresponding percentage. Column (4) is the percentage of teachers in a UA school who are UA teachers. Years 2013-2016.

Table 2. Schools and teachers in the analytic sample

	(1)	(2)		(3)	(4)	
	N Schools	N UA Schools	% UA Schools	N of All Active UA Teachers	N Matched Teachers with Test Scores	% Matched UA Teachers with Test Scores
2013	461	105	22.8	356	174	48.9
2014	458	148	32.3	501	248	49.5
2015	453	186	41.1	617	298	48.3
2016	443	185	41.8	508	226	44.5
Total (unique)	514	212	41.2	796	477	59.9

Notes: Column (1) is the total number of schools in the analytic sample. Column (2) is the total number of UA schools and the corresponding percentage as a share of column (1). Column (3) is the number of all UA teachers in NYC public schools each year (including those not in our final sample). Column (4) is the number of UA teachers we are able to match with students with 8th grade test scores and the corresponding percentage as a share of column (3). Years 2013-2016.

Table 3. Characteristics of students in analytic sample

Percent of students who are:	Percent
Female	48.6
Hispanic	42.0
Black	27.1
White	13.9
Asian	16.0
Student with disability	17.1
English language learner	13.0
Native-born	79.5
Free/reduced lunch eligible	76.4
Proficient on science exam	54.2
Ever taught by UA teacher	33.1
Average science z-score	0.013
Number of observations	223,775
Number of schools	514
Number of teachers	1,717

Notes: Years 2013-2016

Table 4. Impact of having a UA teacher in the current year on 8th grade science exam z-scores

	(1)	(2)	(3)
Have a UA teacher	-0.009	0.054	0.070**
	(0.026)	(0.043)	(0.029)
Teacher Years at DOE		0.003	0.003**
		(0.002)	(0.001)
UA Teacher * Years at DOE		-0.008*	-0.008***
		(0.005)	(0.003)
Teacher Years in UA		0.002	0.004
		(0.007)	(0.005)
Black	-0.735***	-0.735***	-0.330***
	(0.024)	(0.025)	(0.011)
Hispanic	-0.464***	-0.462***	-0.181***
	(0.019)	(0.019)	(0.009)
Asian	0.192***	0.190***	0.222***
	(0.020)	(0.020)	(0.011)
Female	-0.036***	-0.036***	-0.049***
	(0.005)	(0.005)	(0.004)
Student with Disability	-0.629***	-0.628***	-0.604***
	(0.012)	(0.011)	(0.009)
English Language Learner	-0.921***	-0.921***	-0.829***
	(0.017)	(0.017)	(0.013)
Free/reduced lunch eligible	-0.161***	-0.160***	-0.078***
	(0.009)	(0.009)	(0.006)
Native-Born	0.076***	0.076***	0.022***
	(0.008)	(0.008)	(0.006)
Constant	0.711***	0.684***	0.419***
	(0.024)	(0.027)	(0.018)
Year FE	Y	Y	Y
School FE	N	N	Y
N	223,775	223,775	223,775
adj. R^2	0.297	0.297	0.419

Robust standard errors clustered by teacher in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Excluded from the analysis are District 75 schools, charter schools, schools with less than 10 students and teachers with less than 10 students. Years 2013-2016.

Table 5. Impact of having a UA teacher in the current year on meeting proficiency standards and percentiles on the 8th grade science exam

	Scoring Proficient			Percentile		
	(1)	(2)	(3)	(4)	(5)	(6)
Have a UA teacher	-0.003	0.029	0.034***	-0.307	1.718	2.200**
	(0.011)	(0.018)	(0.012)	(0.786)	(1.303)	(0.893)
Teacher Years at DOE		0.001	0.001		0.083	0.094**
		(0.001)	(0.001)		(0.061)	(0.044)
UA Teacher*Years at DOE		-0.004**	-0.003***		-0.258*	-0.246***
		(0.002)	(0.001)		(0.142)	(0.091)
Teacher Years in UA		0.000	0.001		0.035	0.087
		(0.003)	(0.002)		(0.200)	(0.154)
Constant	0.890***	0.883***	0.770***	71.104***	70.315***	62.366***
	(0.009)	(0.011)	(0.008)	(0.724)	(0.824)	(0.546)
Year FE	Y	Y	Y	Y	Y	Y
Student Characteristics	Y	Y	Y	Y	Y	Y
School FE	N	N	Y	N	N	Y
N	223,775	223,775	223,775	223,775	223,775	223,775
adj. R^2	0.217	0.218	0.306	0.299	0.299	0.423

Robust standard errors clustered by teacher in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Linear probability models. In New York State proficiency is scoring in level 3 or 4. Student characteristics not shown: Black, Hispanic, Asian, Female, student with disability, English language learner, free/reduced lunch eligible, native-born. In New York State proficiency is scoring in level 3 or 4. Excluded from the analysis are District 75 schools, charter schools, schools with less than 10 students and teachers with less than 10 students. Years 2013-2016.

Table 6. Impact of having a current UA teacher compared to ever having a UA teacher on 8th grade science exam z-score, meeting proficient standards, and percentiles

	Z-Score			Scoring Proficient			Percentiles		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Currently have UA teacher	-0.006	0.059	0.100***	-0.003	0.031	0.045***	-0.251	1.822	2.980***
	(0.027)	(0.047)	(0.036)	(0.012)	(0.020)	(0.015)	(0.815)	(1.421)	(1.103)
Ever have UA Teacher	0.019	0.015	0.064*	0.005	0.006	0.025*	0.452	0.340	1.697
(excludes current UA)	(0.041)	(0.050)	(0.035)	(0.016)	(0.021)	(0.015)	(1.251)	(1.530)	(1.080)
Teacher Years at DOE		0.003	0.003**		0.001	0.001		0.082	0.097**
		(0.002)	(0.001)		(0.001)	(0.001)		(0.061)	(0.044)
UA Teacher*Years at DOE		-0.008*	-0.007**		-0.004**	-0.003***		-0.253*	-0.220**
		(0.005)	(0.003)		(0.002)	(0.001)		(0.142)	(0.094)
Teacher Years in UA		0.000	-0.002		-0.000	-0.001		0.007	-0.053
		(0.008)	(0.006)		(0.003)	(0.003)		(0.246)	(0.192)
Constant	0.707***	0.682***	0.407***	0.889***	0.882***	0.765***	71.030***	70.275***	62.054***
	(0.024)	(0.028)	(0.019)	(0.009)	(0.011)	(0.008)	(0.737)	(0.856)	(0.570)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Student Characteristics	Y	Y	Y	Y	Y	Y	Y	Y	Y
School FE	N	N	Y	N	N	Y	N	N	Y
N	223,775	223,775	223,775	223,775	223,775	223,775	223,775	223,775	223,775
adj. R^2	0.297	0.297	0.419	0.218	0.218	0.306	0.299	0.299	0.423

Robust standard errors clustered by teacher in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Columns (4) – (6) are linear probability models. In New York State proficiency is scoring in level 3 or 4. Student characteristics not shown: Black, Hispanic, Asian, Female, student with disability, English language learner, free/reduced lunch eligible, native-born. Excluded from the analysis are District 75 schools, charter schools, schools with less than 10 students and teachers with less than 10 students. Years 2013-2016.

ROBUSTNESS CHECKS

Table 7. Impact of having a UA teacher in the current year on 8th grade science exam z-scores, meeting proficiency standards, and percentiles. Propensity score models matched on schools.

	Z-score			**Scoring Proficient**			**Percentiles**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Have a UA teacher	-0.022	0.047	0.064**	-0.008	0.026	0.031**	-0.715	1.485	2.020**
	(0.027)	(0.045)	(0.030)	(0.011)	(0.019)	(0.012)	(0.796)	(1.356)	(0.927)
Teacher Years at DOE		0.003	0.003*		0.001	0.001		0.077	0.088*
		(0.002)	(0.001)		(0.001)	(0.001)		(0.063)	(0.045)
UA Teacher*Years at DOE		-0.008	-0.007**		-0.004*	-0.003***		-0.237	-0.215**
		(0.005)	(0.003)		(0.002)	(0.001)		(0.147)	(0.094)
Teacher Years in UA		-0.002	0.002		-0.001	-0.000		-0.068	0.033
		(0.007)	(0.005)		(0.003)	(0.002)		(0.207)	(0.162)
Constant	0.700***	0.678***	0.409***	0.885***	0.880***	0.766***	70.957***	70.285***	62.286***
	(0.024)	(0.027)	(0.019)	(0.009)	(0.011)	(0.008)	(0.731)	(0.831)	(0.558)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Student Characteristics	Y	Y	Y	Y	Y	Y	Y	Y	Y
School FE	N	N	Y	N	N	Y	N	N	Y
N	210,191	210,191	210,191	210,191	210,191	210,191	210,191	210,191	210,191
adj. R^2	0.299	0.299	0.420	0.219	0.219	0.307	0.301	0.301	0.424

Robust standard errors clustered by teacher in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Columns (4) – (6) are linear probability models. In New York State proficiency is scoring in level 3 or 4. Student characteristics not shown: Black, Hispanic, Asian, Female, student with disability, English language learner, free/reduced lunch eligible, native-born. Excluded from the analysis are District 75 schools, charter schools, schools with less than 10 students and teachers with less than 10 students. Years 2013-2016.

Table 8. Impact of having a current UA compared to ever having a UA teacher on 8th grade science exam z-score, meeting proficient standards, and percentiles. Propensity score models matched on schools.

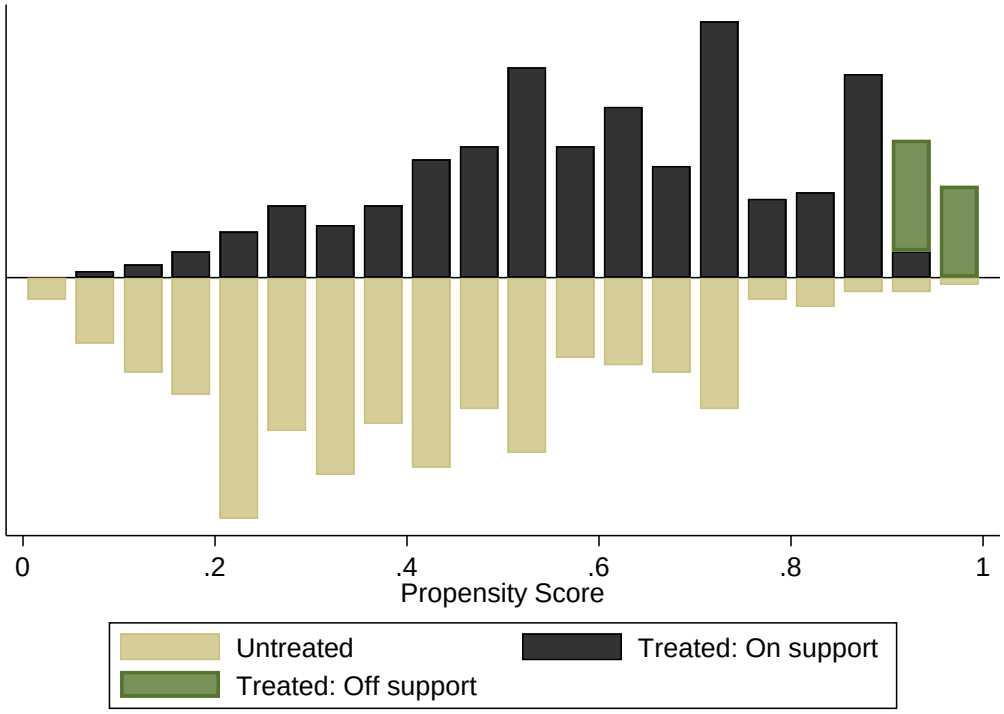
	Z-score			**Scoring Proficient**			**Percentiles**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Currently have UA teacher	-0.019	0.058	0.095**	-0.008	0.031	0.043***	-0.649	1.795	2.851**
	(0.028)	(0.049)	(0.037)	(0.012)	(0.020)	(0.015)	(0.828)	(1.482)	(1.151)
Ever have UA Teacher	0.021	0.037	0.068*	0.007	0.017	0.027*	0.543	1.029	1.799
(excludes current UA)	(0.043)	(0.052)	(0.036)	(0.017)	(0.022)	(0.016)	(1.296)	(1.580)	(1.118)
Teacher Years at DOE		0.003	0.003**		0.001	0.001		0.077	0.092**
		(0.002)	(0.001)		(0.001)	(0.001)		(0.063)	(0.045)
UA Teacher*Years at DOE		-0.007	-0.006*		-0.003*	-0.003**		-0.222	-0.188*
		(0.005)	(0.003)		(0.002)	(0.001)		(0.148)	(0.097)
Teacher Years in UA		-0.005	-0.004		-0.003	-0.002		-0.158	-0.119
		(0.008)	(0.007)		(0.004)	(0.003)		(0.255)	(0.203)
Constant	0.696***	0.673***	0.397***	0.883***	0.878***	0.761***	70.864***	70.152***	61.951***
	(0.024)	(0.029)	(0.019)	(0.009)	(0.011)	(0.009)	(0.745)	(0.867)	(0.583)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Student Characteristics	Y	Y	Y	Y	Y	Y	Y	Y	Y
School FE	N	N	Y	N	N	Y	N	N	Y
N	210,191	210,191	210,191	210,191	210,191	210,191	210,191	210,191	210,191
adj. R^2	0.299	0.299	0.420	0.219	0.219	0.307	0.301	0.301	0.424

Robust standard errors clustered by teacher in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Columns (4) – (6) are linear probability models. In New York State proficiency is scoring in level 3 or 4. Student characteristics not shown: Black, Hispanic, Asian, Female, student with disability, English language learner, free/reduced lunch eligible, native-born. Excluded from the analysis are District 75 schools, charter schools, schools with less than 10 students and teachers with less than 10 students. Years 2013-2016.

Appendix

Figure 1A. Region of common support, propensity score matching



Notes: *Untreated* are schools who never participated in UA. *Treated* are schools who participated in UA. Figure illustrates strong overlap between treatment and control schools.

Table A1. Balance across UA and non-UA schools from propensity score matching

Dependent variable: ever UA school	(1)
Demographic characteristics:	
Average attendance rate	0.002
	(0.001)
Enrollment	0.000
	(0.000)
Percent Asian	0.012
	(0.033)
Percent Black	0.011
	(0.033)
Percent Hispanic	0.008
	(0.033)
Percent White	0.008
	(0.033)
Percent Female	0.007
	(0.005)
Percent Immigrant	-0.008
	(0.006)
Percent ELL	0.006
	(0.005)
Percent Special Ed.	-0.001
	(0.004)
Percent of students passing math exam	0.001
	(0.003)
Percent of students passing English exam	-0.003
	(0.004)
Percent eligible for free lunch	-0.001
	(0.001)
Percent eligible for reduced price lunch	0.002
	(0.005)
Universal free meal school	0.075
	(0.062)
Percent of students passing science exam	0.014
	(0.181)
Per pupil general ed. spending	-0.000
	(0.000)
Per pupil special ed. spending	-0.000
	(0.000)
Percent of teachers without valid teaching certificate	-0.002
	(0.005)
Percent of teachers with fewer than 3 years of experience	0.001
	(0.002)
Teacher pupil ratio	0.006

	(0.017)
Borough:	
BX	-0.003
	(0.066)
BK	-0.011
	(0.069)
QN	0.017
	(0.083)
SI	0.207
	(0.196)
Constant	-0.773
	(3.345)
N	552

Robust standard errors clustered at the school level in parentheses* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Notes: Dependent variable is a binary indicator equal to 1 if a school ever had a teacher who participated in UA (i.e. ever UA school). Linear probability model regression of the treatment (ever UA) on covariates. Estimates show no statistically significant differences between the treatment and control schools on all covariates.

Impact on Students at Renewal Schools

The Renewal Schools Program began in 2014 to provide additional support to schools that met three criteria: identified by New York State Department of Education as a Priority or Focus School; demonstrated low academic performance in 2012, 2013 and 2014 school years; and scored proficient or below on their most recent quality review.[10] Thirty-three of the schools had already been participating in the UA program prior to their inclusion in this program. At the request of UA and the NYCDOE, we conducted similar analyses to those above to examine the impact of UA on science test scores. Our findings are reported in Table A2. In general, students of UA teachers at Renewal schools score positively higher than those of non-UA teachers but these results are not statistically significant, including in our preferred specification that compares students within the same school. The magnitude of estimates in Table A2 is comparable to other results in this report and one theory is that with a relatively small sample of renewal schools may not give enough power to detect a statistically significant impact.

[10] http://schools.nyc.gov/AboutUs/schools/RenewalSchools/default#about

Table A2: Impact of having a UA teacher on science exams in renewal schools

	Z-Score			Scoring Levels 3 and 4			Percentiles		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Have a UA Teacher	0.076*	0.088	0.074	0.030	0.030	0.024	1.159	2.285	2.850
	(0.042)	(0.069)	(0.066)	(0.019)	(0.032)	(0.030)	(1.180)	(2.023)	(1.893)
Years Teaching at DOE		-0.002	-0.005		-0.001	-0.003**		0.042	-0.046
		(0.003)	(0.003)		(0.001)	(0.001)		(0.062)	(0.087)
UA Teacher*Yrs at DOE		-0.003	0.006		-0.002	0.002		-0.134	-0.067
		(0.008)	(0.008)		(0.003)	(0.003)		(0.247)	(0.260)
Teacher Yrs in UA		0.003	0.003		0.003	0.004		-0.091	0.364
		(0.013)	(0.014)		(0.006)	(0.006)		(0.403)	(0.407)
Constant	-0.350***	-0.339***	-0.431***	0.448***	0.458***	0.420***	52.541***	52.260***	50.876***
	(0.085)	(0.089)	(0.075)	(0.043)	(0.044)	(0.036)	(1.951)	(2.074)	(1.911)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Student Characteristics	Y	Y	Y	Y	Y	Y	Y	Y	Y
School FE	N	N	Y	N	N	Y	N	N	Y
R-sqr	17,774	17,774	17,774	17,774	17,774	17,774	17,774	17,774	17,774
N	0.151	0.151	0.210	0.089	0.090	0.135	0.160	0.160	0.184

Robust standard errors clustered by teacher in parentheses + p<0.1, * p<0.05, ** p<0.01

Notes: Student characteristics not shown: Black, Hispanic, Asian, Female, student with disability, English language learner, poor, native-born. Excluded from the analysis are District 75 and charter schools. In New York State proficiency is scoring in level 3 or 4. Years 2013-2016.