TEACH FOR AMERICA TEACHERS IN DUVAL COUNTY PUBLIC SCHOOLS: AN ANALYSIS OF RETENTION AND PERFORMANCE

Final Report
August 29, 2014

Douglas D. Ready, Ph.D.
Associate Professor of Education and Public Policy
Teachers College, Columbia University
ddr2111@columbia.edu

Contents

Executive Summary

In 2011, Duval County Public Schools (DCPS) was awarded a three-year Race to the Top grant from the U.S. Department of Education to facilitate a partnership with Teach for America (TFA). TFA already had a strong prior presence in Duval County, with over 200 TFA corps members serving the district before the grant award. DCPS sought to achieve two aims with the new funds. First, the district hoped to recruit and train 300 new TFA teachers to serve DCPS students. This first aim has been met, with roughly 100 new TFA teachers entering DCPS classrooms during each year of this three-year grant. Second, the district sought to implement programs and policies to improve retention and performance among TFA teachers. This report examines the extent to which this second set of goals has been realized.

Summary of Part 1 Results:

- Across five cohorts of first-year DCPS teachers, 84% of TFA corps members returned to begin a second year of teaching compared to 77.1% of non-TFA teachers. But only 32% of these TFA teachers returned for a third year compared to 63.7% of non-TFA teachers.
- Even compared to early-career teachers in the same school with similar backgrounds and teaching responsibilities, TFA teachers were still more likely to leave DCPS.
- TFA membership was the strongest single predictor of early-career attrition from DCPS.
- Although far too early to speculate on causal impacts, descriptive analyses suggest that TFA corps members hired under the new grant were somewhat more likely to return to begin a third year of teaching compared to earlier cohort members (43.1% versus 26.7%).

Summary of Part 2 Results:

- To estimate academic effectiveness among TFA and other teachers, this report used three separate analytic strategies that sought to account for the fact that TFA teachers were on average less experienced, less likely to have majored in education as undergraduates or be traditionally certified, and typically served socially and academically less-advantaged students and schools.
- Two of these three strategies indicated that students gained slightly more math and literacy skills with TFA teachers, while a third suggested that TFA and non-TFA students learned at comparable rates.
- But these estimates of TFA effects (when significant) were all quite small (none larger than 0.07 standard deviations).
- The results suggest no differences in TFA teacher performance pre- versus post-grant.

Teach For America Teachers in Duval County Public Schools:
An Analysis of Retention and Performance

Introduction

In 2011, Duval County Public Schools (DCPS) was awarded a three-year Race to the Top grant from the U.S. Department of Education to facilitate a partnership with Teach for America (TFA). TFA already had a strong prior presence in Duval County, with over 200 TFA corps members serving the district before the grant award. DCPS sought to achieve two aims with the new funds. First, the district hoped to recruit and train 300 new TFA teachers to serve DCPS students. This first aim has been met, with roughly 100 new TFA teachers entering DCPS classrooms during each year of this three-year grant. Second, the district sought to implement programs and policies to improve retention and performance among TFA teachers. To achieve these aims, grant funds were intended to facilitate:

- Tighter partnerships between DCPS and TFA in terms of teacher hiring, curriculum development, and assessment alignment;
- Summer instructional institutes for TFA corps members;
- Increased professional development for TFA teachers;
- Efforts to retain TFA teachers and alumni in both instructional and administrative positions with the school district.[1]

Assessing the extent to which DCPS met the second set of goals related to TFA teacher retention and performance is the focus of the analyses presented below. The report is divided into two sections, each of which addresses a critical question related to the effectiveness of TFA in DCPS. Part 1 examines retention rates among five cohorts of TFA and other early-career DCPS teachers, and explores the extent to which differences in teacher personal and professional backgrounds and school placements between TFA and non-TFA teachers explain differential rates of attrition. Part 2 then estimates the impact of TFA teachers on student academic growth for the 2008-2009 through 2013-2014 school years. The analyses also compare TFA teacher retention rates and student outcomes prior to and after the grant award to examine the extent to

[1] These analyses do not examine implementation, and thus cannot speak to the fidelity with which these stated aims were enacted.

which the activities associated with the grant may have improved performance and retention among TFA teachers. The report begins with a brief review of the extant literature related to teacher retention, particularly as it relates to Teach for American corps members.

Part 1: Retention among TFA and other Early-Career Teachers

Although organizations typically benefit from a certain degree of turnover, high levels of turnover can negatively influence organizational stability and performance. Attrition among early-career teachers has been a particular concern among practitioners and policymakers. Recent estimates suggest that roughly one-quarter of new teachers leave teaching within the first two years, and almost half leave the classroom within five years (Ingersoll, 2003).[2] Although comparisons to other professions might provide perspective as to whether such turnover rates are a cause for concern, past research has failed to reach a consensus on the relative magnitude of teacher attrition. Some authors have argued that the teacher turnover rate is relatively low compared with other professions (Henke & Zahn, 2001). Others have concluded that teacher attrition rates are comparable to those for young workers in such fields as nursing, social work, and accounting (Harris & Adams, 2007), but higher than rates among higher-status professions (e.g., technology and scientific professionals, university faculty) and lower than lower-status, lower-skilled personnel (e.g., federal clerical workers; Ingersoll, 2003).

Interest in teacher attrition stems in part from its potential influences on student outcomes (Ronfeldt, Loeb, & Wyckoff, 2013). Although turnover of ineffective teachers is beneficial, the opposite is true if teachers who leave the profession are more effective than those who replace them. This is particularly troubling because evidence suggests that new teachers are generally less effective than more experienced teachers (Rivkin, Hanushek, & Kain, 2005; Ronfeldt, et al., 2013). Furthermore, the most academically proficient teachers are most likely to leave the profession altogether. Teachers with higher ACT and NTE licensure test scores, those with degrees in technical subjects such as chemistry, and those who graduate from more selective colleges tend to leave teaching earlier than others (Goldhaber, Gross, & Player, 2007; Murnane & Olsen, 1989, 1990; Podgursky, Monroe, & Watson, 2004). On the other hand, more effective teachers tend to stay in the classroom longer than less effective teachers (Boyd, Grossman, Hammerness, Lankford, Loeb, Ronfeldt, & Wyckoff, 2010; Goldhaber et al., 2007; Hanushek, Kain, & Rivkin, 2004).

Teacher turnover may have organizational implications beyond the characteristics of the teachers who remain, including disruptive influences that affect all members of a school

[2] Although these retention rates seem quite low, it is instructive to understand that younger workers in general are more likely to change jobs and careers.

community (Ingersoll, 2003; Ronfeldt et al., 2013). Even if replacement teachers are as effective as those who departed, turnover and the attendant staff "churn" may still harm the effectiveness of the teachers who remain. As teachers exit, they take with them institutional knowledge and memory that facilitate relational trust and collegiality. Remaining teachers also often bear the responsibility of having to mentor new teachers and carry more of the instructional burden (Ronfeldt et al., 2013). Further troubling for schools is the circular finding that teachers with high academic qualifications are more likely to exit if their colleagues have weaker qualifications (Podgursky et al., 2004).

A central critique of the TFA program is that attrition rates are higher among TFA teachers compared to other early-career teachers. Evidence suggests that many TFA teachers intend to leave teaching once their two-year commitment is complete; only 11% of TFA teachers in one study expected to remain in teaching as long as they were able and none expected to teach until retirement, substantially below the 69% of new, traditionally trained teachers who expected to remain (Decker, Mayer, & Glazerman, 2004). This difference in expected teaching career length corresponds with the exit behavior of TFA and other new teachers across several cities. Almost 60% of TFA mathematics teachers in New York City departed after two years of service, and over 75% left by the end of year three (Boyd et al., 2010). The comparable attrition rates for new, traditionally trained teachers were 19.1% and 27.7% after two and three years, respectively. In Houston in the late 1990s, between 58-81% of TFA teachers left the district by the end of the second year (depending on the cohort), and 85-96% departed before the end of three years (Darling-Hammond, Holtzman, Gatlin, & Helig, 2005). Among comparable early-career Houston teachers, 23-51% had left by the end of year two, and between 35-55% had left by the end of year three. Another Texas study found that in the first two years the 5-11% attrition rates of TFA teachers were lower than the 13-17% attrition rates of non-TFA teachers (Ware, LaTurner, Parosns, Okulicz-Kozaryn, Garland, & Klopfenstein, 2011). However, in the third year, the attrition rates of TFA teachers climbed to 44-59%, while the attrition rates of non-TFA teachers only reached 19-24%. In Louisiana, attrition rates of TFA teachers were similar to other teachers in the first two years, but then dropped dramatically following that year, with up to 96% of TFA teachers leaving after five years of teaching, compared to only 35% of new, traditionally trained teachers (Noell & Gansle, 2009).

The dramatically higher attrition rates of TFA teachers across years and contexts raise

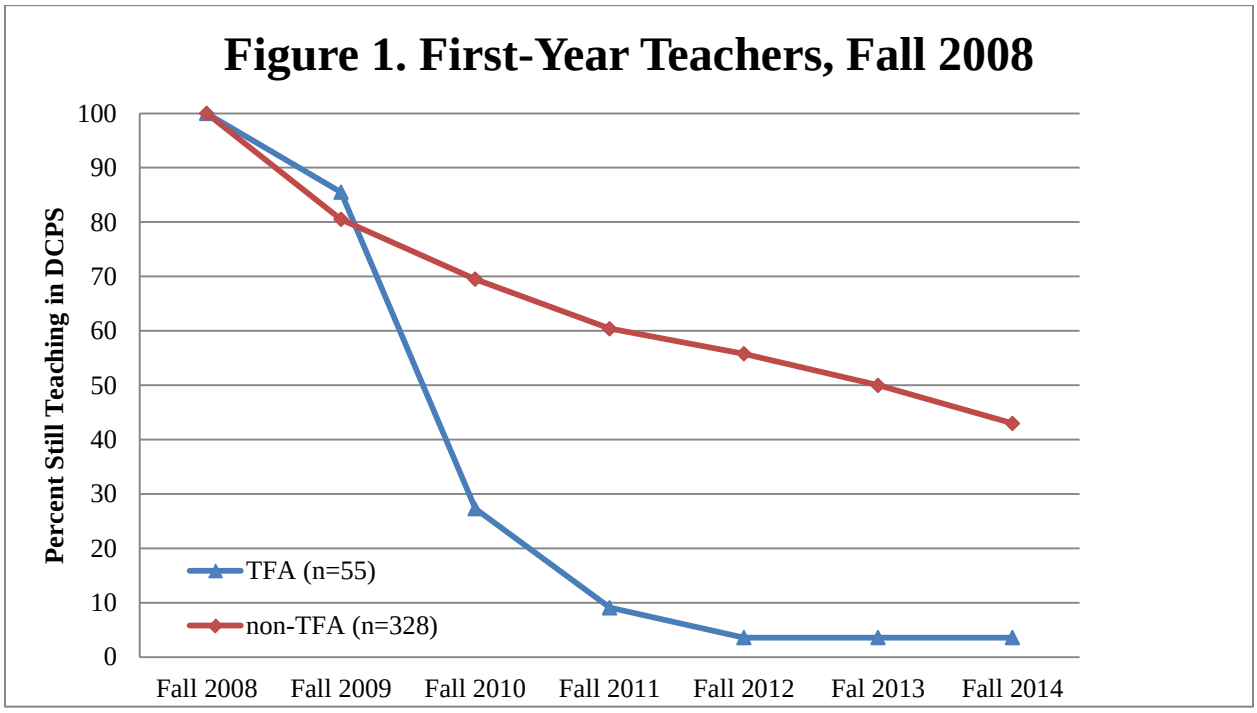
many questions. The analyses below explore attrition rates for five cohorts of TFA and other early-career DCPS teachers who started teaching during the 2008-2009 through 2012-2013 school years. The aim here is to identify personal and professional background characteristics associated with these different lengths of service. How can we compare attrition rates between TFA and non-TFA DCPS teachers, and what factors might explain any differences?

2008 Cohort

At the start of the 2008-2009 school year, 383 individuals entered DCPS classroom as first-year teachers, including 55 TFA and 328 non-TFA teachers.[3] As displayed in Figure 1 below, 47 of the 55 TFA teachers (85.5%) returned in Fall 2009 to start their second year of teaching. A slightly smaller (but statistically non-significant) proportion of non-TFA teachers returned for their second year of teaching (264 of 328, or 80.5%). Although comparable after year one, these retention rates diverged sharply after the second year when the traditional two-year TFA commitment ends. Only 15 of the original 55 TFA teachers (27.3%) began year three, compared to 228 of original 328 non-TFA teachers (69.5%; $p<.001$). Retention disparities continued to widen further over subsequent years. After three years, only five of the original 55 TFA teachers (9.1%) remained, compared to 198 of the original 328 first-year non-TFA teachers (60.4%; $p<.001$).[4] By the end of year four, only two of the original 55 TFA teachers (3.6%) continued to teach in DCPS. In contrast, 183 of the original 328 non-TFA teachers (55.8%) remained teaching in Duval County ($p<.001$). The same two TFA teachers present during the 2012-2013 academic year returned to begin their sixth year of service for the 2013-2014 academic year, compared to exactly half (164) of the original 328 non-TFA teachers ($p<.001$). DCPS again employed the same two TFA teachers at the start of the 2014-2015 academic year, and employed less than half of the original non-TFA cohort (141 of 328, or 43%; $p<.001$).

[3] Although also considered by DCPS to be "first-year teachers," these numbers do not include teachers who began teaching in DCPS at any point during the previous school year, nor teachers who began in DCPS after the start of the 2008-2009 school year. The exception here is one TFA teacher who began in DCPS in February, 2008. Due to the relatively smaller TFA sample size, this teacher remains in the sample. Specialized staff such as social workers, psychologists, part-time staff and ROTC personnel were also eliminated from all analyses.

[4] All calculations include teachers who left the system for one or more years during this period, but who later returned. For example, two non-TFA teachers from the 2008-2009 novice cohort were not teaching in the system for the 2009-2010 school year, but returned for the 2010-2011 school year. For 2010-2011, 38 early-career teachers left the system, but when we consider the two teachers from the original first-year-teacher cohort who returned, we find a loss of 36 teachers.

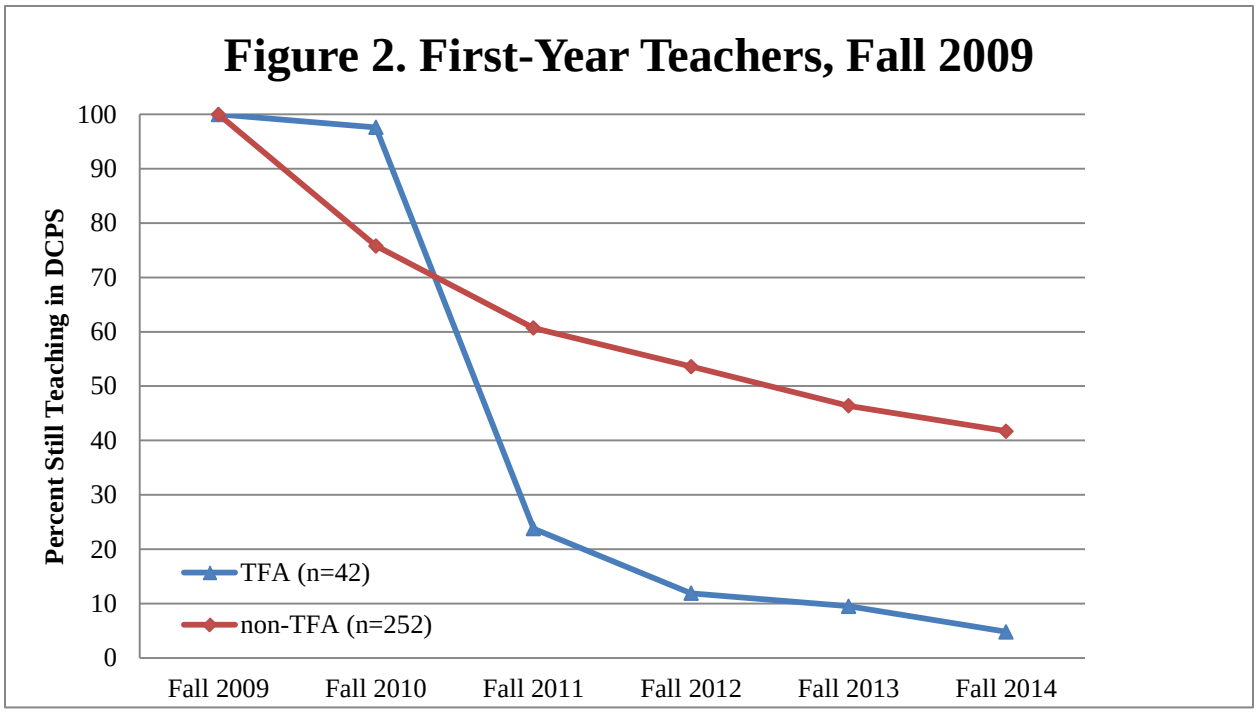


2009 Cohort

DCPS hired 294 first-year teachers for the start of the 2009-2010 school year, including 42 who were associated with TFA (see Figure 2).[5] Virtually all TFA teachers returned to start a second year (41 of 42, or 97.6%) compared to only three of four non-TFA teachers (191 of 252, or 75.8%; $p<.001$). After two years, however, TFA teachers were much more likely than non-TFA teachers to have left the school system: only ten of the original 42 TFA teachers remained at the start of the 2011-2012 school year (23.8%), compared to 153 of the original 252 non-TFA teachers (60.7%; $p<.001$).[6] As with the 2008-2009 cohort, these teachers generally fulfilled their commitment to stay in the classroom for two years, but departed soon thereafter.[7] By the start of year four, meaning they had completed at least three years of teaching, five of the original 42 TFA teachers remained (11.9%), compared to 135 of the original 252 non-TFA teachers (53.6%;

[5] These numbers include one TFA teacher who was in her third year of teaching when she started with DCPS.
[6] 42 non-TFA teachers left before the start of their third year, but four teachers returned for the 2011-2012 school year who were not present for the 2010-2011 school year, for a total loss of 38 teachers.
[7] Two 2009 TFA corps members departed after two years (were not present for the 2011-2012 school year) but returned for both the 2012-2013 and 2013-2014 academic years, but had departed prior to the start of the 2014-2015 school year.

p<.001).[8] Four members of this TFA cohort began the 2013-2014 school year in DCPS (9.5%) compared to just under half of non-TFA members (117 of 252, or 46.4%; p<.001). Two members (4.8%) of the original 2009 cohort returned to DCPS for the current school year, compared to 41.7% of the non-TFA cohort (105 of 252; p<.001).

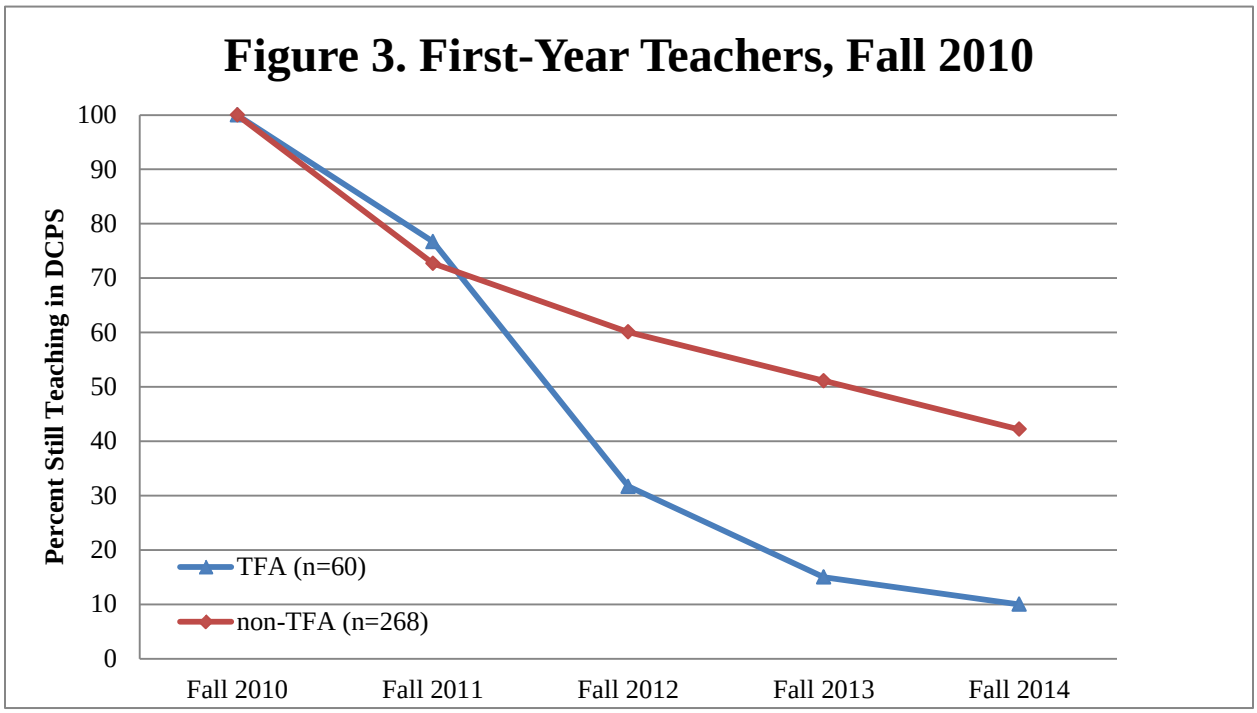


2010 Cohort

DCPS had 328 first-year teachers in place for the start of the 2010-2011 school year, including 60 affiliated with TFA (see Figure 3).[9] Among the TFA teachers, 46 returned to start year two (76.7%) compared to a statistically comparable 196 of 268 non-TFA teachers (73.1%). Stark differences again appear after year two, when only 19 of the 60 TFA teachers returned for a third year (31.7%) compared to 60.1% of other teachers (161 of 268; p<.001).[10] Nine (15%) of the original TFA members returned for the 2013-2014 school year, while 137 (51.1%) of their non-TFA cohort peers did so (p<.001). For the current academic year, 10% of the original 60

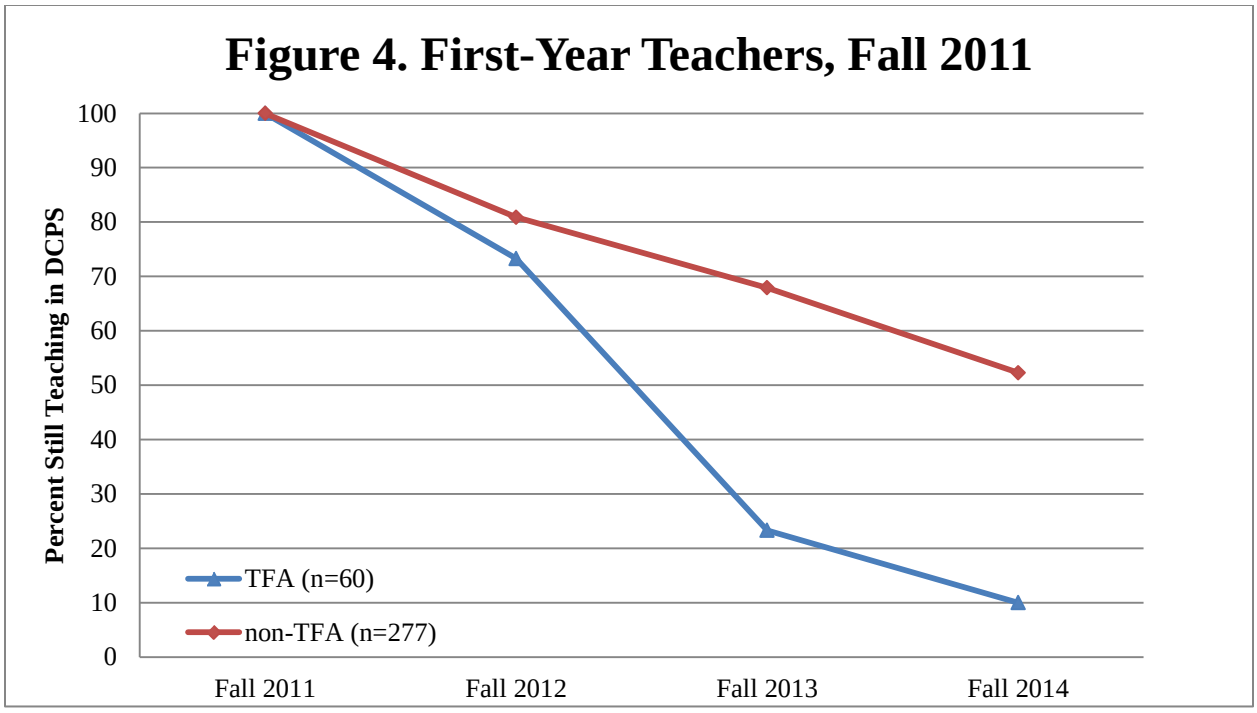
[8] 21 non-TFA teachers left before the start of their fourth year, but three returned who were not present for the 2011-2012 school year, for a total loss of 18 teachers.
[9] One TFA teacher did not begin until September 13th, but is nonetheless included in these calculations.
[10] 38 non-TFA teachers departed, but four teachers returned, for a total loss of 34.

TFA corps members remained in DCPS classrooms, compared to 42.2% of non-TFA teachers (111 of 268; $p<.001$).



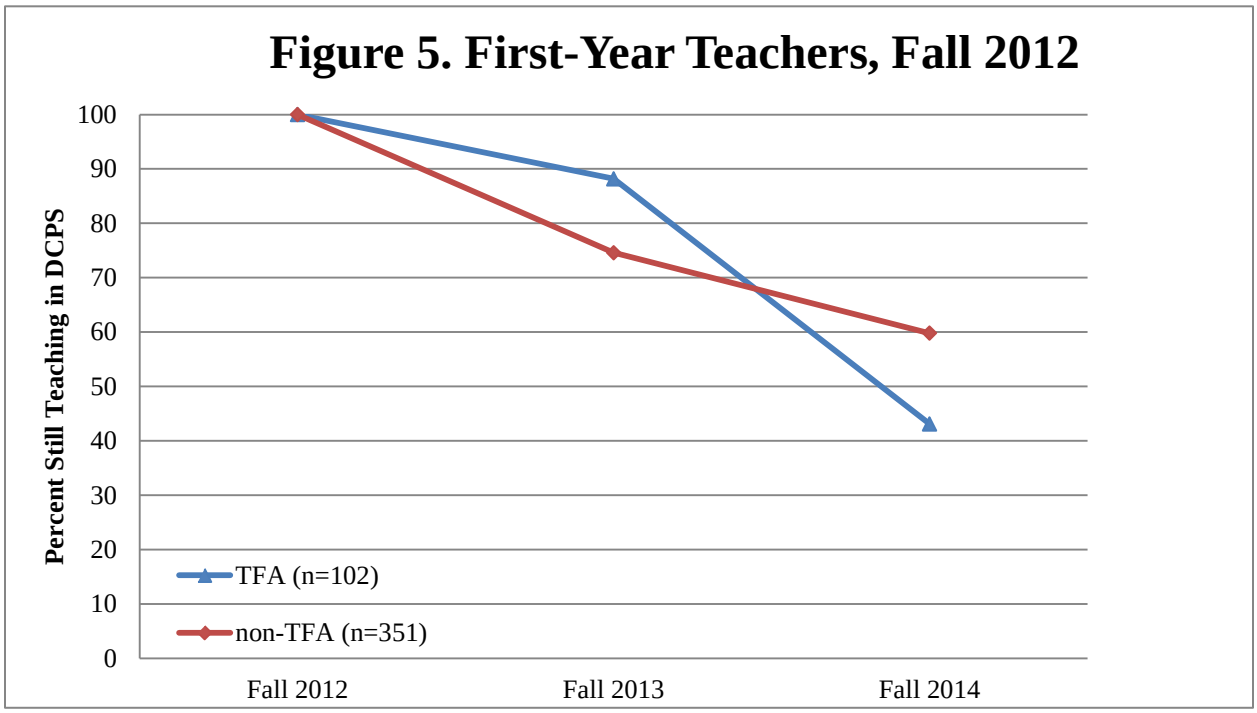
2011 Cohort

For the 2011-2012 school year, 60 new TFA corps members were hired by DCPS, as were 277 non-TFA first-year teachers. As with all previous years, retention rates between the two groups were quite similar at the start of year two, with 73.3% of TFA (44 of 60) and 80.9% (224 of 277) of non-TFA teachers returning ($p>.05$). The divergence again occurs after two years. In Fall 2013, less than one-quarter (23.3%; 14 of 60) of TFA teachers had returned to begin their third year of teaching, compared to over two-thirds (67.9%; 188 of 277) of non-TFA teachers ($p<.001$). For the 2014-2015 school year, 10% of the original 2011 TFA corps members remained with DCPS (six of 60) compared to just over half of their non-TFA teaching peers (145 of 277, or 52.3%; $p<.001$).



2012 Cohort

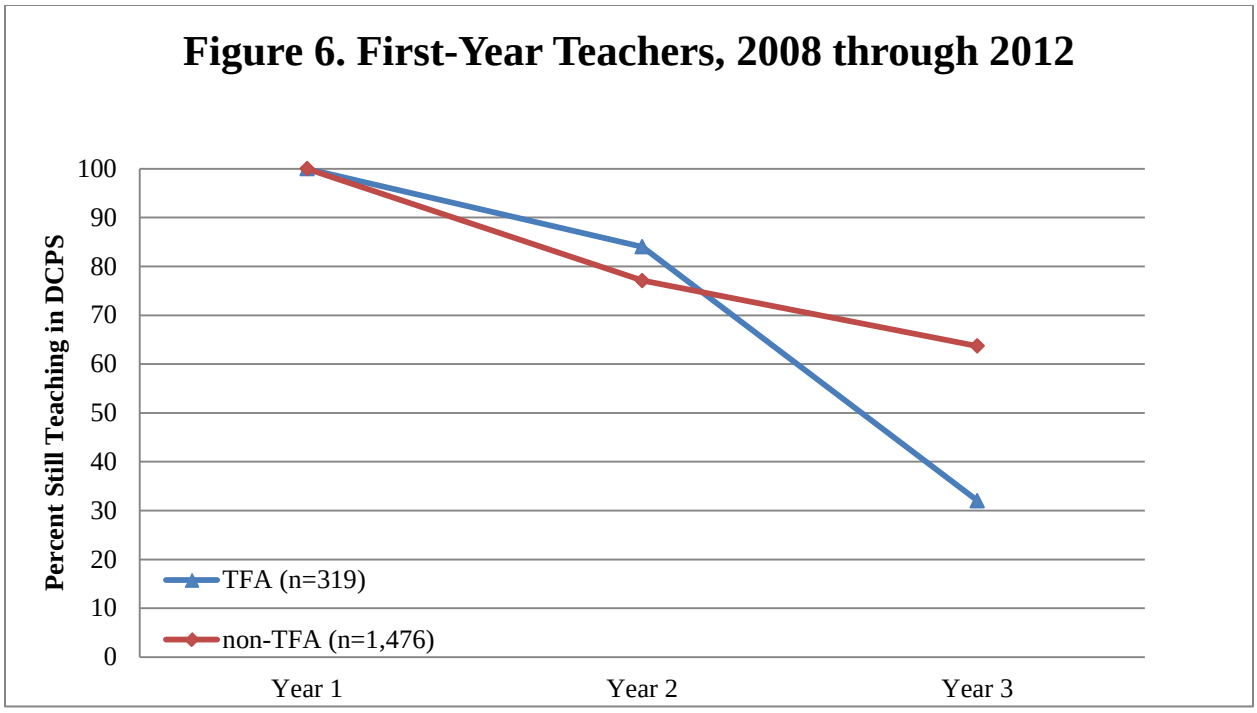
DCPS hired 351 first-year non-TFA teachers for Fall 2012, as well as 102 novice TFA corps members, who represented the first group of TFA teachers hired under the Race to the Top grant. Roughly 88% of these TFA teachers returned to start year two (89 of 101), compared to 74.7% of non-TFA teachers (263 of 352; $p<.01$). Almost 60% of non-TFA teachers returned for year three (210 of 351) compared to 43.1% of TFA corps members (44 of 102; $p<.01$).



Combined Cohort Analysis

Figure 6 below displays the combined results for the first two years of service across these five cohorts of novice DCPS teachers. Among the 319 TFA corps members, 268 (84%) returned for a second year, compared to 77.1% (1,138) of the 1,476 non-TFA teachers ($p<.01$). The important pattern across cohorts, however, is the higher departure rate among TFA teachers after year two. Roughly one in three (102 of 319, or 32%) TFA teachers started a third year of DCPS service compared to almost two of three (940 of 1,476, or 63.7%) non-TFA teachers ($p<.001$).

One important question is whether TFA corps member retention rates improved with the efforts related to the Race to the Top grant. Although it is far too early to report causal impacts, descriptive analyses do show some promise. Compared to the previous four TFA cohorts (2008-2011), members of the 2012 cohort, who were the first hired under the new grant, were equally likely to return to begin year two of teaching (88.2% versus 82% for previous cohorts; $p>.05$). However, TFA teachers hired in 2012 were more likely to return to begin year three compared to earlier cohort members (43.1% versus 26.7%; $p<.01$).



Former TFA Teachers Serving other Duval County Schools

Each year over the past several years, a number of TFA teachers who resigned their positions in DCPS have accepted teaching positions in non-DCPS Duval County charter schools. For example, ten members of the 2010 TFA cohort who had left DCPS were teaching in Duval County charter schools during the 2012-2013 school year. Because the TFA cohort sizes are relatively small, even this small number of TFA teachers who move to Duval County charter schools reduces the TFA attrition rate. With the 2010 cohort, when we view the ten former DCPS TFA teachers teaching in Duval County charter schools as still active, the three-year TFA retention rate rises from roughly 33% (19 of 29) to almost 50% (29 of 60 teachers were still active in a DCPS or Duval County charter school). To be fair, it is likely that a small number of non-TFA teachers may have also left DCPS to serve area charter schools, thus reducing their attrition rate as well. However, human resources data on Duval County charter schools were not available to the author at the time this report was completed.

The sections that follow begin to unpack these findings regarding the differential retention rates between TFA and non-TFA teachers. What explains the shorter DCPS careers of TFA teachers? Can we identify personal and professional background characteristics that are associated with departure, and which are in turn associated with being a TFA versus non-TFA

teacher? Or do these differential attrition rates flow from the fact that TFA and their non-TFA colleagues teach in different types of schools that serve demonstrably different students?

Background Differences between TFA and non-TFA Teachers

This section begins with an exploration of the demographic, academic, and professional background differences that distinguish TFA and non-TFA teachers. The aim here is to shed light on differences that may potentially explain why TFA teachers leave DCPS at such higher rates. Table 1 indicates no statistically significant gender differences by TFA status. Across both groups, roughly three-quarters were female. There were small differences in racial/ethnic composition across groups, with TFA teachers somewhat more likely to be Hispanic, Native American, and multiracial, and somewhat less likely to be Asian, black, and white. These two groups, however, differed considerably more across many other important dimensions. TFA teachers were on average over seven years younger than their non-TFA colleagues. This is unsurprising given the program's focus on recruiting recent college graduates. Another artifact of TFA's program design is that fewer than one in four TFA teachers had majored in education as an undergraduate, compared to over half of non-TFA, first-year teachers. Relatedly, virtually all TFA teachers held temporary teaching certificates, compared to just over half of non-TFA, first-year teachers. Moreover, almost all TFA teachers were teaching core academic subjects, compared to just over four of five non-TFA teachers.

On average, TFA and non-TFA teachers also attended different types of colleges and universities. While almost three of four non-TFA teachers had received their undergraduate degrees from a Florida college or university (70.9%), only one of four TFA teachers had done so (27.9%). One could plausibly extrapolate that TFA teachers were less likely to have personal and/or professional ties to Florida, and were thus less likely to stay. In addition to this geographic difference, the colleges attended by these two groups differed academically as well. The colleges attended by TFA members were more selective, as indicated by their somewhat lower acceptance rates and substantially higher average ACT and SAT scores.[11]

Equally large differences are evident in the types of DCPS schools to which TFA and non-TFA teachers were initially assigned. The average TFA teacher was placed in a school with a black enrollment of 83.1%, and a poverty rate of 77.7%. In contrast, black enrollments and

[11] Note that these are institutional average test scores, not the average test scores for these DCPS teachers.

poverty rates for the schools served by non-TFA teachers were both roughly 60%. Even larger disparities in school characteristics were found with student test scores. Average mathematics achievement in the schools staffed by TFA teachers was 0.62 standard deviations below that of schools served by non-TFA teachers, while average reading achievement was 0.77 standard deviations lower. These quite sizable differences are again understandable, given TFA's mission to serve high-poverty, high-needs schools. Curiously, however, TFA teachers typically taught in schools with somewhat smaller proportions of Hispanic and ELL students. Student attendance rates did not vary across the schools served by TFA and non-TFA early-career teachers.

Table 1. Demographic, Academic, and Professional Backgrounds of TFA and non-TFA First-Year Teachers, Fall 2008 through Fall 2012

	TFA (n=318)	Non-TFA (n=1,477)
% Female	75.5	75.1
Age (years) at start in DCPS***	23.4	30.5
*Race/Ethnicity**		
% Asian	1.6	2.3
% Black	18.9	21.2
% Hispanic	10.4	6.6
% Native American	0.9	0.3
% White	64.0	67.5
% Multiracial	4.1	2.0
% Undergraduate Education Major***	23.6	51.9
Certification Status		
Temporary Teaching Certificate***	90.9	51.7
Regular Teaching Certificate	7.9	47.3
Unknown Certificate Status	1.3	1.0
*Teaching Responsibility****		
Core Academic[1]	96.2	82.2
Special Education	2.5	11.0
Elective/Other	1.3	6.8
Characteristics of Undergraduate Institution		
Florida College/University ***	27.9	70.9
Acceptance Rate (%)***	53.1	59.7
ACT Composite Scores***	25.6	22.7
SAT Composite Scores***	595.5	554.6
Characteristics of First DCPS School Assigned		
% Black***	83.1	58.0
% Hispanic***	3.4	6.2
% Free/Reduced Lunch***	77.7	60.9
% ELL***	3.5	7.1
School-Average Student Absences (per year)	8.5	8.4
School-Average Mathematics Achievement***	-0.51	0.11
School-Average Reading Achievement***	-0.64	0.13

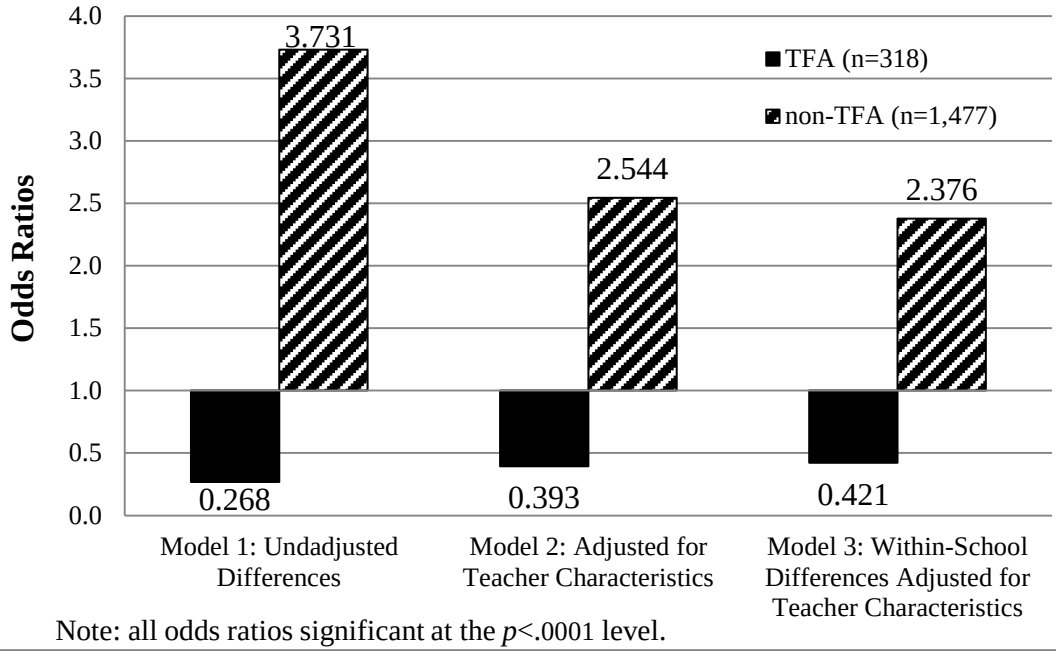
*$p<.05$; ***$p<.001$

1. Core academic includes: regular K-6 classroom teachers; grade 7-12 mathematics, English, Social Studies, Science, ESL and Foreign Language Teachers. In addition to special education teachers, this category includes dropout prevention staff and speech pathologists. Elective includes: art, drama, music, gifted/talented, computers, media specialists, health, as well as all vocational education teachers.

Which Novice Teachers Left?

One challenge in understanding why TFA teachers were so much more likely to leave DCPS is the overlapping nature of many of the teacher characteristics discussed above. The analyses presented below in Figure 7, which employ the same sample of 1,795 novice teachers used in Figure 6, attempt to disentangle these complicated relationships. The bars on the far left of the figure (labeled Model 1) present the unadjusted odds ratios for TFA and non-TFA teachers.[12] The outcome here is returning to DCPS to begin a third year of teaching. Reflecting the findings above, Model 1 indicates that non-TFA teachers were far more likely to return to DCPS to begin a third year of teaching. Specifically, the odds of returning among non-TFA teachers were almost four times greater compared to TFA corps members. Conversely, TFA teachers' odds of returning were roughly one-quarter those of their non-TFA early-career peers.

Figure 7. Explaining Retention Disparities between TFA and non-TFA teachers



Note: all odds ratios significant at the $p<.0001$ level.

[12] Odds ratios of one indicate that two groups are equally likely to experience a given outcome; odds ratios of two indicate odds that are twice as large; odds ratios of 0.5 indicate odds that are half as large. Although redundant, the odds ratios for both TFA and non-TFA teachers are shown here to better display the convergence toward one as teacher-level covariates and school fixed-effects are introduced.

However, as we know from Table 1 above, TFA and non-TFA DCPS teachers differ in many important respects. Model 2 adjusts these odds ratios for academic, demographic, and professional background differences that distinguish TFA from non-TFA teachers. In other words, how comparable would retention rates have been for TFA and non-TFA teachers if they had shared similar educational backgrounds, job requirements, and demographic characteristics? Once we adjust the odds ratios for these teacher characteristics, the disparities converge somewhat. We find that the odds that a non-TFA teacher would have returned are now only 2.5 times greater than TFA members', while TFA teachers' odds are now roughly 40% of their non-TFA colleagues.

We also know that TFA teachers were situated in DCPS schools that enrolled socially and academically less advantaged students. In addition to their personal backgrounds, the more challenging educational environments in which TFA teachers typically served may partly explain their weaker retention rates. The bars labeled Model 3 in Figure 7 indicate the odds ratios for TFA and other teachers who were teaching in the same schools. Note that again the odds ratios for each group converge further when we only compare teachers who served the same students. When we do so, we find that non-TFA teachers' odds of returning were roughly 2.4 times those of TFA teachers, while TFA teachers had odds that approached half those of their non-TFA peers. This all suggests that TFA teachers may have been slightly less likely to resign had they taught in schools that resembled those served by non-TFA teachers. Conversely, non-TFA teachers would have been somewhat *more* likely to leave the district if they had been placed in schools similar to those served by the average TFA teacher.

In summary, even after controlling for all available teacher characteristics and removing unmeasured differences across schools, these analyses suggest that TFA teachers were still less likely to begin a third year of service compared to their non-TFA counterparts.[13] Importantly, TFA membership was the strongest single predictor of attrition from the district among early-career teachers during this five-year period. The full results of the models used to create Figure 6 are included as Table 6 in Appendix A. The report now turns to analyses that explored achievement differences among students who experienced TFA and non-TFA teachers.

[13] Model 3 was also re-run as a linear probability model. The results suggest that the probability that TFA teachers returned for a third year of teaching was 22.3 percentage points below that of non-TFA teachers in the same school, controlling for teacher background characteristics.

Part 2: TFA Teachers and Student Performance

While studies universally report higher attrition rates among TFA teachers, findings regarding the impact of TFA teachers on student learning are far more nuanced, and vary across studies, contexts, grades, and subjects. One reason for these incongruities across outcomes is that unlike analyses exploring TFA retention rates, which are relatively straightforward, studies that seek to estimate how much students learn with TFA versus non-TFA teachers are fraught with conceptual and methodological complexities. In general, previous research has reported that student literacy achievement is comparable across TFA and non-TFA teachers, all else equal (Henry, Thompson, Bastian, Fortner, Kershaw, Purtell, & Zulli, 2010; Kane, Rockoff, & Staiger, 2008; Turner, Goodman, Adachi, Brite, & Decker, 2012). However, one study reported that compared to other novice teachers, TFA teachers had a slight positive effect on students' reading scores (Noell & Gansle, 2009), while another concluded that TFA teachers had a small negative effect (Darling-Hammond et al., 2005).

With mathematics, the weight of the evidence suggests that TFA teachers are at least as effective, or possibly more effective, compared to their non-TFA colleagues. However, these findings may vary based on certification status. For example, one study claims that the negative effect of having an uncertified TFA teacher (*ES* [effect size] = -0.099 to -0.246) was greater than the negative effect of having a non-TFA uncertified teacher (*ES* = -0.018 to -0.148), but relative to teachers with standard certification, certified TFA teachers were more effective (*ES* = 0.113; Darling-Hammond et al., 2005). The magnitude of potential TFA effects on mathematics learning may also depend on the experience levels of the comparison teachers. Compared to all non-TFA teachers, several studies suggest that TFA teachers are as effective or slightly more effective (*ES* = 0.02 to 0.15; Boyd, et al. 2010; Henry, et al., 2010; Noell & Gansle, 2009; Kane et al., 2008). However, compared to other novice teachers, TFA teachers may have larger positive impacts (*ES* = 0.19; Noell & Gansle, 2009; Turner et al., 2012).

The most rigorous analyses of TFA effects include two random assignment studies conducted by Mathematica (Decker et al., 2004; Clark, Chiang, Silva, McConnel, Sonnenfeld, Erbe, & Puma, 2013). Decker and colleagues (2004) examined literacy and mathematics achievement of students in grades one through five, while Clark et al. (2013) examined mathematics achievement of mostly (75%) middle school students and some (25%) high school students. Both studies randomly assigned students within schools to teachers prior to the start of

the school year. Similar to the other studies cited above, Decker et al. (2004) found no differences in student literacy development between TFA and non-TFA teachers. However, both Mathematica studies reported that, on average, TFA teachers were more effective than non-TFA teachers in preparing students for the mathematics assessments (*ES* = 0.15 for Decker et al., 2004; *ES* = 0.07 for Clark et al., 2013). These effects were slightly larger when TFA teachers were compared only to other novice teachers (*ES* = 0.26 for Decker et al., 2004; *ES* = 0.08 for Clark et al., 2013).

Expanding on this extant research, the analyses below compare student learning among DCPS students assigned to TFA versus non-TFA teachers between the 2007-2008 and 2013-2014 school years. In contrast to the retention analyses above, the performance analyses include all TFA corps members who taught a tested subject and grade during this period. As with many of the studies described above, the analyses below entail several different model specifications, each of which addresses slightly different variations of the same question: over the past several years, have Duval County students learned as much from TFA teachers as they have from non-TFA teachers?

Mathematics Skills Development

The bars in Figure 8 indicate differences in mathematics performance on the Florida Comprehensive Assessment Test (FCAT) between students assigned to TFA teachers in DCPS and those assigned to non-TFA teachers (who are represented by the zero line).[14] As noted above, TFA teachers are typically allotted to schools serving lower-achieving students. This is quite evident here. As indicated by the bar on the far left of the figure, on average, students with TFA teachers scored over one-quarter standard deviation lower on the mathematics assessments than other students.[15] However, our interest is not in static indicators of achievement. Rather, the focus here is on how much students learned the years they were with TFA versus non-TFA teachers. The second bar in Figure 8 provides the answer to this question by displaying differences in student mathematics *gains*. Across years and grades, students who had mathematics instruction with TFA teachers gained slightly fewer mathematics skills compared to those assigned to non-TFA teachers ($p<.001$).

[14] The full results of these models are presented below in Tables 2-5.
[15] These estimates are fixed for both grade and year, and therefore compare TFA and non-TFA students in the same grade, in the same year.

These initial models, however, do not yet account for the fact that TFA teachers more often serve socially and academically disadvantaged students, who typically learn somewhat less during the academic year. The analytic model represented by the third bar accounts for the fact that on average, TFA teachers serve students with different socio-demographic backgrounds compared to their non-TFA colleagues. The mathematics gain estimate here is adjusted for student race/ethnicity, gender, absences, mobility, and free/reduced-price lunch, special education, and ELL status, as well as classroom-level aggregate indicators of these student-level characteristics (percent black and Hispanic, free/reduced-price lunch, special education, and ELL). Once we account for these student-level and contextual characteristics, the TFA estimate turns slightly positive (*ES* = 0.033; $p<.001$). This suggests that if TFA and non-TFA teachers were assigned to the same types of students and taught in similar classroom contexts, TFA students would likely perform slightly better in mathematics compared to students with non-TFA teachers. Importantly, this is the case even before adjusting for teacher experience, background, or training.

The fourth model displayed in Figure 8 recognizes that early-career teachers are on average less effective than more experienced teachers, and that TFA corps members have typically been in the classroom for fewer than two years. Hence, the effectiveness of TFA versus other teachers may be masked by their relative inexperience. To address this, the fourth bar from the left further adjusts student mathematics gains for teacher experience (and its quadratic).[16] Note that the TFA estimate becomes slightly larger (*ES* = 0.046; $p<.001$). The fifth bar in the figure then adds additional controls for teacher certification status, and whether the teacher majored in education and/or mathematics as an undergraduate.[17] The estimate here is virtually unchanged from the previous model, with TFA students gaining roughly 0.05 standard deviations more per year on an adjusted basis ($p<.001$).

The final two models in Figure 8 include school fixed-effects, which compare TFA and non-TFA teachers in the same school, thus removing all unmeasured differences across schools that might influence student academic growth. We find here that students with TFA and non-

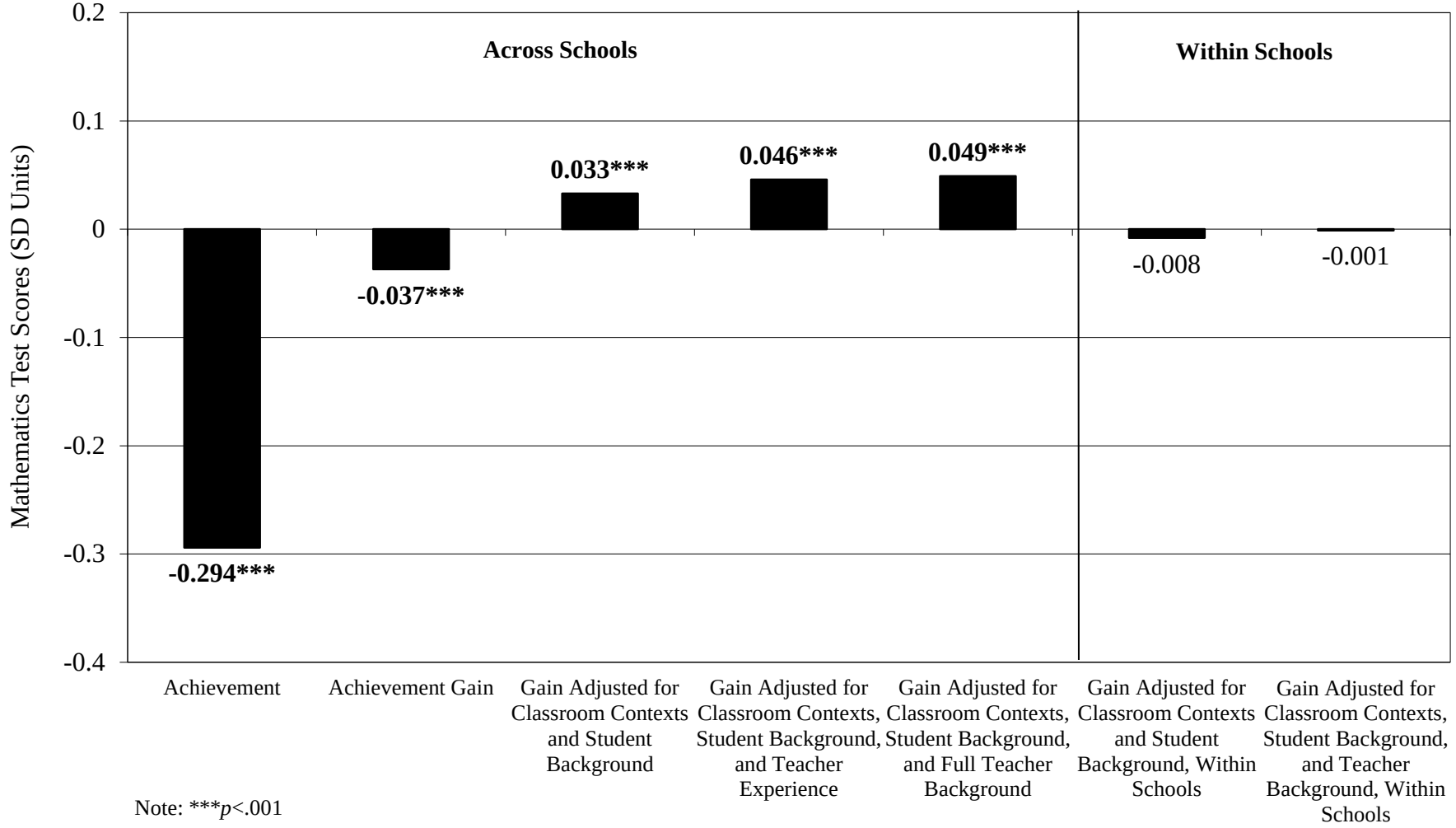
[16] Including the quadratic (squared term) in the model accounts for the fact that the relationship between teacher experience and student achievement gains is non-liner. Specifically, teacher effectiveness increases dramatically during the first few years of teaching, but plateaus after roughly year six or seven.
[17] Includes students who majored in math or math education, physics or physics education, computer science, engineering, economics, accounting, or statistics.

TFA teachers gained mathematics skills at statistically comparable rates (p>.05). Analyses not included here also explored whether TFA teachers were differentially effective with free/reduced-price eligible, black, and Hispanic students. The results provided no evidence that this was the case. Other models also investigated whether the TFA estimated effects varied pre- and post-grant. Estimates across these time periods were virtually identical and any differences not statistically significant.

The mathematics outcome models summarized in Figure 9, which are substantively and conceptually quite different from those in Figure 8, compare mathematics achievement in years when a student had a TFA teacher versus years when the same student had a non-TFA teacher. In a sense, these models represent the effects of the "treatment on the treated"—the effects of having a TFA teacher among students who did in fact experience a TFA teacher. The great benefit of this approach is that it removes all unmeasured differences across students who did and did not experience a TFA teacher, as students essentially serve as their own control or counterfactual. Another important advantage of the analyses in Figure 9 is that they capture learning among third graders, who are excluded from the analyses in Figure 8, given that second-grade pre-test scores are not available. (The models in Figure 9 do not require pre-test scores. See Appendix B for more information.)

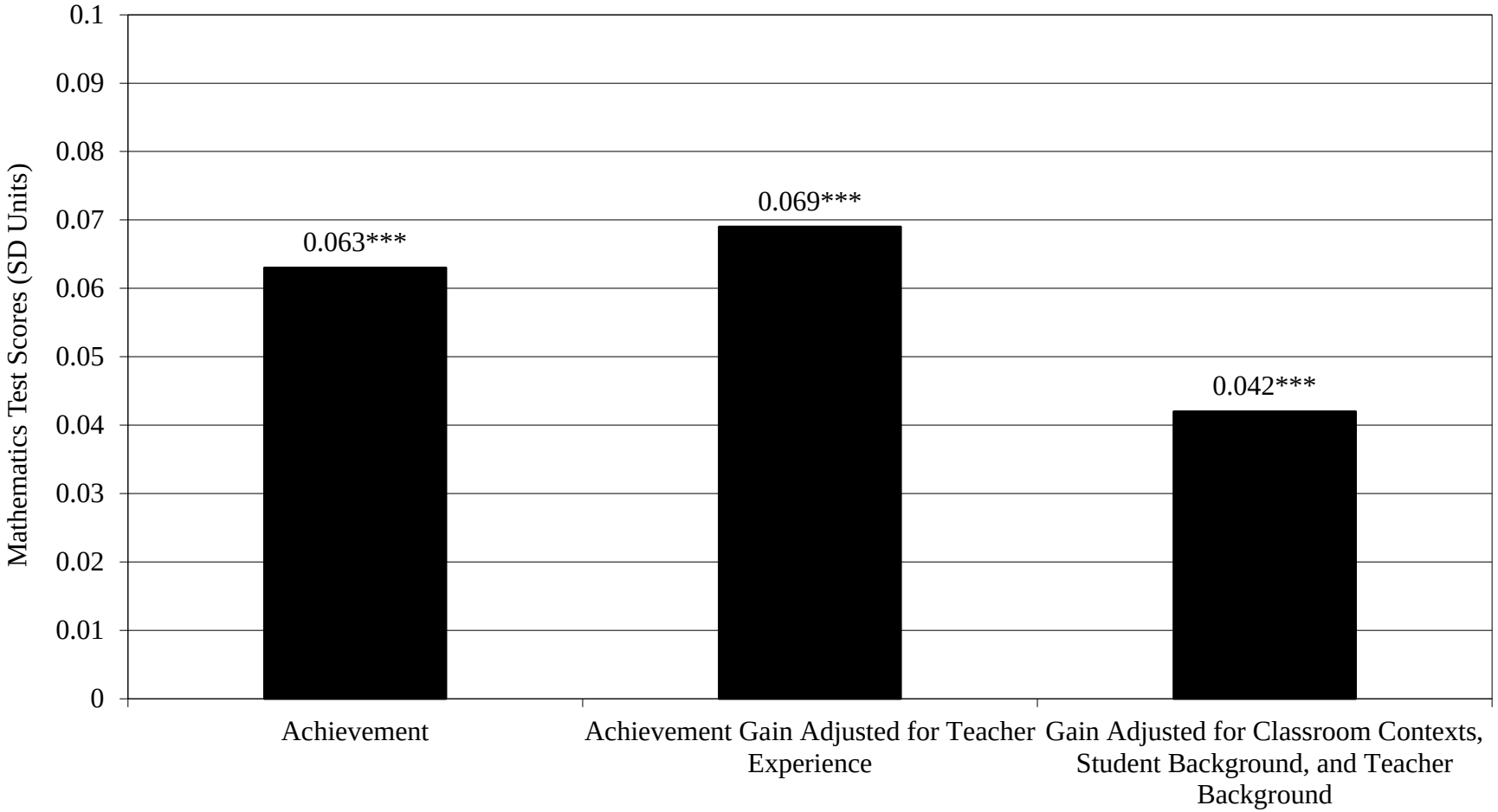
As indicated by the bar on the far left of Figure 9, student mathematics performance was somewhat higher in years when students had a TFA teacher compared to years when these students did not (ES = 0.063; p<.001), and slightly higher still in the second bar when we account for the fact that the average TFA teacher had fewer years of teaching experience (ES = 0.069; p<.001). With these within-student models, holding a regular teaching certificate and an undergraduate degree in education were negatively associated with student mathematics scores, while having been an undergraduate mathematics major was positively associated. In the final bar on the right, which accounts for the fact that TFA teachers are less likely to be certified and to have undergraduate degrees in education, and are more likely to have been mathematics majors, we find that the TFA estimate is reduced somewhat, but remains both positive and statistically significant (yet small; ES = 0.042; p<.001).

Figure 8. Comparing Student Mathematics Performance Across TFA and non-TFA Teachers



Note: ***p<.001

Figure 9. Comparing Student Mathematics Performance Across TFA and non-TFA Teachers: Within-Student Models



Note: ***p<.001

Reading Skills Development

The analytic models for reading development are virtually identical to those used for mathematics, although the results differ somewhat. As with mathematics, the first bar on the left in Figure 10 indicates that students assigned to a TFA teacher scored considerably lower on the FCAT literacy assessments than students assigned to other teachers (*ES* = -0.376; $p<.001$). As with mathematics, the second bar suggests that these students fell even further behind during their year with a TFA teacher, with the initial gap widening by roughly one-tenth of a standard deviation. However, when we account for differences in the types of students and classrooms served by TFA teachers in the third model, we find that students assigned to TFA teachers learned only slightly less compared to students assigned to other types of teachers (*ES* = -0.037; $p<.001$). When we adjust for teacher experience with the fourth bar, the negative effect associated with TFA status is again reduced slightly (*ES* = -0.025; $p<.001$), but remains unchanged when we further control for teacher training and education in the fifth bar.

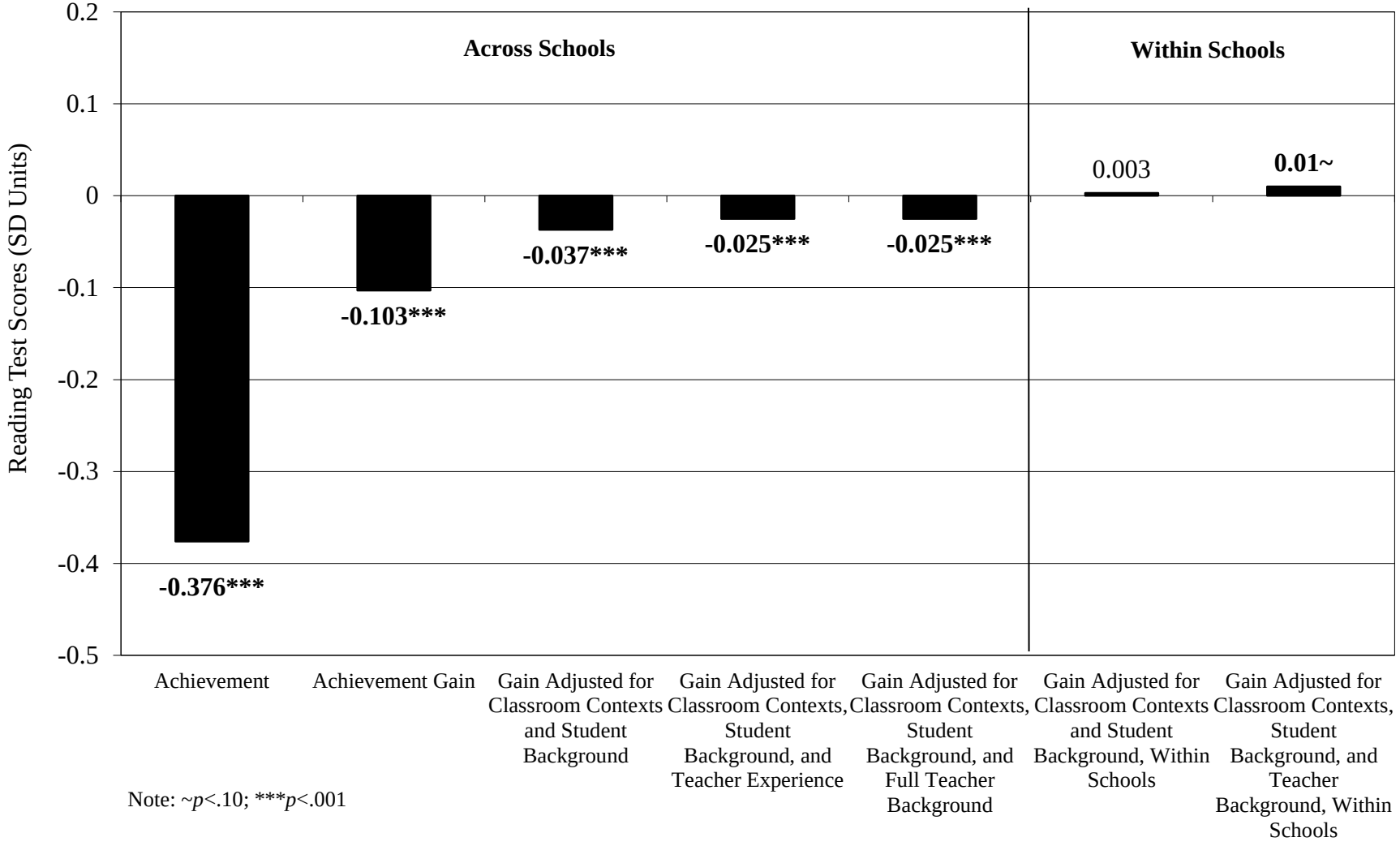
The sixth and seventh models then compare TFA and non-TFA teachers in the same schools. We see now that compared to others in the same school, students assigned to TFA teachers gained skills at a rate statistically comparable to other students during the academic year ($p>.05$). But when teacher background differences between TFA and non-TFA teachers are fully accounted for, we find a trivial (and only marginally significant) advantage in favor of TFA teachers (*ES* = 0.01; $p<.10$).

As with mathematics, analyses not included here also explored whether TFA teachers' literacy instruction was differentially effective with free/reduced-price eligible, black, and Hispanic students, or whether the TFA estimated effects varied pre- and post-grant. Again, the models provided no evidence in support.

The reading models in Figure 11 compare reading performance among students the year(s) they had a TFA teacher to the year(s) they had non-TFA teachers. As with mathematics, the results here suggest that student reading performance was slightly higher in years when students had a TFA teacher (*ES* = 0.018; $p<.001$), and somewhat higher still in the second bar when we account for the fact that the average TFA teacher was less experienced (*ES* = 0.025; $p<.001$). In contrast to the mathematics results, however, in the final model, which fully adjusts for teacher background characteristics, we find no difference in reading performance during the years when a student did and did not have a TFA teacher ($p>.05$). This makes sense, in that

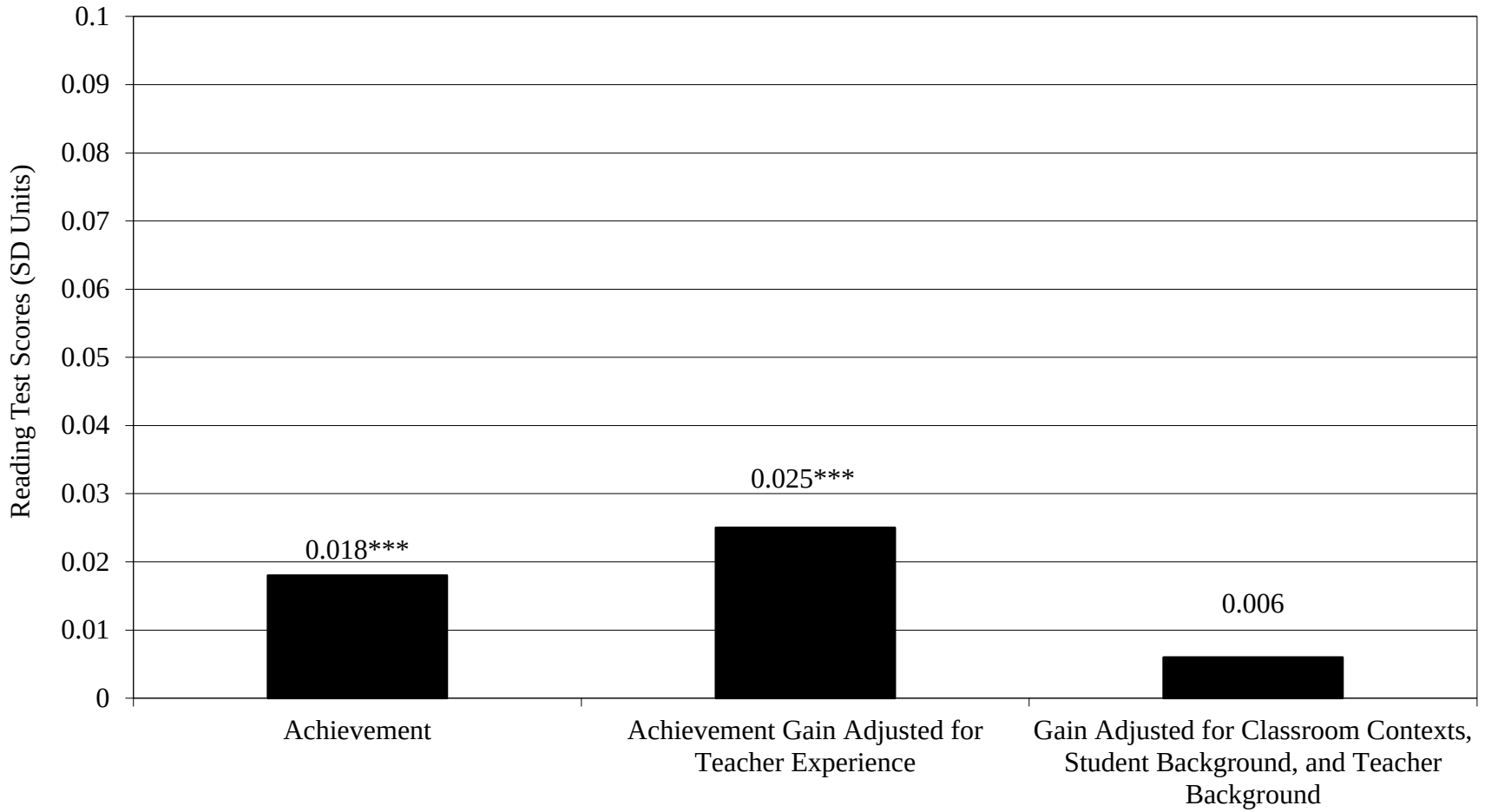
related estimates from this model suggest that holding a regular teaching certificate and/or an undergraduate degree in education are *negatively* related to student reading performance, adjusted for other student and teacher characteristics. Importantly, TFA teachers were *less* likely to be certified or to have been education majors. Controlling for this explains a portion of the TFA advantage indicated by the previous model.

Figure 10. Comparing Student Reading Performance Across TFA and non-TFA Teachers



Note: ~p<.10; ***p<.001

Figure 11. Comparing Student Reading Performance Across TFA and non-TFA Teachers: Within-Student Models



Note: ****p*<.001

Summary and Conclusions

Over the past several years, TFA teachers have left Duval County at rates considerably higher than their non-TFA early-career peers. Among TFA teachers who started in the five-year period from Fall 2008 through Fall 2012, only 32% stayed beyond their two-year teaching commitment. The comparable retention rate for other teachers was 63.7%. These disparities can be explained in part by the demographic, academic, and professional differences that distinguished TFA and non-TFA teachers on their first day in a Duval County classroom. TFA teachers attended more selective colleges and universities, and these institutions were less likely to be located in Florida. TFA members were also less likely to possess regular teaching certificates. These attributes were associated with increased teacher attrition among *all* teachers, not just TFA members. But importantly, these traits were more *common* among TFA compared to non-TFA teachers. Moreover, by design, TFA teachers were disproportionately assigned to high-needs schools. These schools enrolled considerably larger proportions of low-income and black children, and students who struggled academically. Taken collectively, we can begin to understand the greater attrition rates among TFA teachers. However, *even when compared to other early-career teachers in the same school, and even after adjusting for differences in their backgrounds and teaching responsibilities, TFA teachers in these five cohorts were still considerably more likely to leave DCPS.*

There is some very preliminary evidence that TFA retention rates may begin to improve in Duval County. TFA corps members who were hired in 2012 under the auspices of the Race to the Top grant were more likely to return for a third year of service in DCPS compared to TFA teachers in the previous four cohorts. Future research should confirm this trend as data become available.

In contrast to the analyses and findings regarding teacher attrition from DCPS, which were relatively straightforward, the analyses of student achievement differences between TFA and non-TFA teachers were far more nuanced and complex. Within any given year and grade, students of TFA teachers typically *scored* far below other students on state literacy and mathematics assessments. However, these students *gained* mathematics and literacy skills at only slightly lower rates compared to non-TFA students. These comparisons, however, are not altogether appropriate given that TFA teachers were more often assigned to socially and academically less-advantaged students. For example, over 10% of low-income DCPS students

encountered a TFA teacher for reading in grades 3-10 at some point between 2008 and 2014, compared to only 2% of non-low-income students.[18] When we account for these student background differences, as well as the aggregate socio-demographic characteristics of classrooms, we find that TFA students actually gained somewhat more mathematics skills compared to other students, but still gained literacy skills at a slightly slower rate compared to those of non-TFA students. Fully adjusted models that considered differences in teacher background and training as well as differences in the types of schools served by TFA and non-TFA teachers indicate that with both literacy and mathematics *TFA teachers were at least as effective as their non-TFA colleagues*.

Arguably the most robust analyses presented above used students as their own controls or counterfactuals, by comparing achievement in years when students were instructed by a TFA corps member to years in which they were not. The student fixed-effects models that accounted for teacher experience, but not teacher certification or undergraduate major, suggested a small (adjusted) advantage for TFA teachers in both literacy and mathematics. These results closely mirror those reported from other evaluations of TFA (see Decker, 2004; Kane et al, 2006, Turner, et al., 2012). In certain respects these findings can be viewed as supportive of the TFA program. Indeed, the student fixed-effects models suggest that students assigned to TFA teachers performed as well as (or possibly somewhat better than) students assigned to non-TFA teachers, even prior to controlling for student or teacher background characteristics. This also suggests that TFA teachers with only one or two years of experience were on average at least as effective as non-TFA *veteran* teachers.

Regardless of which model one selects as most appropriate, even the statistically significant TFA estimates—both positive and negative— are very, very small, all hovering around zero. In no analyses are statistically significant effects larger than 0.07 standard deviations. Although the relatively small TFA sample size reduces the likelihood of statistically significant TFA estimates, this does not influence the *size* of the estimates, which are again substantively quite small.

Finally, it is important to note that these analyses focused exclusively on mathematics and reading skills development. It seems possible that benefits (or detriments) in other subjects

[18] The disparity is similar for mathematics: 6.3% of low-income students had math instruction at some point from a TFA corps member, compared to only 1% of other students.

or in other domains, such as non-cognitive traits, attitudes, habits or aspirations, might accrue to students as a result of having encountered a TFA teacher in the classroom. Such data were not available for this report. Relatedly, this focus on tested grades and subjects means that TFA teachers in DCPS who did not teach math or reading in grades 3-10 are not included in the analyses. The potential effects of these other TFA teachers remain unknown.

Table 2. Mathematics Performance among Students with TFA and non-TFA Teachers

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Teacher Background							
TFA Teacher	**-0.294*** **	**-0.037** **	**0.033*** **	**0.046*** **	**0.049*** **	**-0.008**	**-0.001**
Experience (years, centered)				0.001***	0.002***		0.001**
Experience squared				-0.0001***	-0.0001***		-0.0001***
Regular Certification					-0.006*		-0.003
Undergraduate education major					0.012***		0.001
Undergraduate math major					0.030***		0.031***
Student Background							
Pre-test (z-scored)		0.805***	0.727***	0.727***	0.726***	0.717***	0.717***
Pre-test squared		0.025***	0.023***	0.022***	0.022***	0.019***	0.019***
Female			-0.001	-0.001	-0.001	-0.003	-0.003
Black (compared to whites)			-0.098***	-0.098***	-0.098***	-0.106***	-0.106***
Hispanic (compared to whites)			-0.016**	-0.016**	-0.017***	-0.021***	-0.021***
Asian (compared to whites)			0.084***	0.084***	0.084***	0.079***	0.079***
Other (compared to whites)			-0.019**	-0.019**	-0.020***	-0.024***	-0.024***
Free/reduced-price lunch			-0.051***	-0.051***	-0.052***	-0.053***	-0.053***
Special education			-0.134***	-0.134***	-0.134***	-0.138***	-0.138***
ELL			-0.013**	-0.013**	-0.013**	-0.013**	-0.013**
Absences			-0.006***	-0.006***	-0.006***	-0.006***	-0.006***
Changed schools mid-year			-0.071***	-0.071***	-0.071***	-0.062***	-0.062***
Classroom Contexts							
Percent black			0.001**	0.001**	0.001***	-0.002***	-0.002***
Percent Hispanic			-0.001~	-0.001~	-0.001~	-0.001**	0.000
Percent free/reduced-price lunch			-0.003***	-0.003***	-0.003***	-0.003***	-0.003***
Percent special education			-0.002***	-0.002***	-0.002***	-0.002***	-0.001***
Percent ELL			0.001	0.001	0.001	-0.001**	-0.001**
Fixed for grade, year	✓	✓	✓	✓	✓		
Fixed for grade, year, school						✓	✓
Constant	0.165***	0.049***	0.349***	0.354***	0.349***	0.449***	0.446***
R^2	0.009***	0.653***	0.670***	0.670***	0.670***	0.694***	0.697***

~p<.10; *p<.05; **p<.01; ***p<.001. Outcome is standardized (z-scored) within grades and years.

Table 3. Mathematics Performance among Students with TFA and non-TFA Teachers: Within-Student Models

	Model 1	Model 2	Model 3
Teacher Background			
TFA Teacher	**0.063*** **	**0.069*** **	**0.042*** **
Experience (years, centered)		0.001***	0.002***
Experience squared		-0.0001***	-0.0001***
Regular Certification			-0.031***
Undergraduate Education Major			-0.012***
Undergraduate Math Major			0.089***
Time-Varying Student Characteristics			
Absences			-0.007***
Changed schools mid-year			-0.027***
Classroom Contexts			
Percent black			0.001**
Percent Hispanic			0.001~
Percent free/reduced-price lunch			-0.002***
Percent special education			0.003***
Percent ELL			-0.002***
Fixed for student	✓	✓	✓
Constant	0.099***	0.106***	0.175***
R^2	0.857***	0.857***	0.859***

~p<.10; *p<.05; **p<.01; ***p<.001. Outcome is standardized (z-scored) within grades and years.

Table 4. Reading Performance among Students with TFA and non-TFA Teachers

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Teacher Background							
TFA Teacher	**-0.376*** **	**-0.103*** **	**-0.037*** **	**-0.025*** **	**-0.025*** **	**0.003**	**0.010~**
Experience (years, centered)				0.002**	0.002***		0.001***
Experience squared				-0.00004***	-0.00004***		-0.00004**
Regular Certification					0.004**		-0.001
Undergraduate education major					-0.008**		-0.002
Student Background							
Pre-test (z-scored)		0.800***	0.715***	0.714***	0.714***	0.696***	0.696***
Pre-test squared		0.018**	0.019***	0.019***	0.019***	0.015***	0.015***
Female			0.020***	0.020***	0.020***	0.018***	0.018***
Black (compared to whites)			-0.120***	-0.120***	-0.120***	-0.117***	-0.117***
Hispanic (compared to whites)			-0.010*	-0.010*	-0.010*	-0.013*	-0.013**
Asian (compared to whites)			0.047***	0.046***	0.046***	0.028**	0.028***
Other (compared to whites)			-0.026***	-0.026***	-0.026***	-0.028***	-0.028***
Free/reduced-price lunch			-0.072***	-0.072***	-0.072***	-0.066***	-0.066***
Special education			-0.159***	-0.160***	-0.160***	-0.163***	-0.163***
ELL			-0.042***	-0.042***	-0.042***	-0.041***	-0.041***
Absences			-0.004***	-0.004***	-0.004***	-0.004***	-0.004***
Changed schools mid-year			-0.039***	-0.039***	-0.039***	-0.033***	-0.033***
Classroom Contexts							
Percent black			0.001***	0.001***	0.001***	-0.002***	-0.001***
Percent Hispanic			0.000	0.000	0.000	0.000	0.000
Percent free/reduced-price lunch			-0.003***	-0.003***	-0.003***	-0.003***	-0.002***
Percent special education			-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
Percent ELL			-0.0003~	-0.0003~	-0.0003*	-0.002***	-0.002***
Fixed for grade, year	✓	✓	✓	✓	✓		
Fixed for grade, year, school						✓	✓
Constant	0.175***	0.042***	0.311***	0.310***	0.311***	0.380***	0.383***
R^2	0.018***	0.642***	0.659***	0.659***	0.659***	0.672***	0.672***

~p<.10; *p<.05; **p<.01; ***p<.001. Outcome is standardized (z-scored) within grades and years.

Table 5. Reading Performance among Students with TFA and non-TFA Teachers: Within-student Models

	Model 1	Model 2	Model 3
Teacher Background			
TFA Teacher	**0.018*** **	**0.025*** **	**0.006**
Experience (years, centered)		0.001***	0.002***
Experience squared		-0.0001***	-0.0001***
Regular Certification			-0.024***
Undergraduate Education Major			-0.023 ***
Time-Varying Student Characteristics			
Absences			-0.005***
Changed schools mid-year			-0.021***
Classroom Contexts			
Percent black			-0.0004***
Percent Hispanic			-0.0005*
Percent free/reduced-price lunch			0.0002*
Percent special education			-0.0001~
Percent ELL			-0.003***
Fixed for student	✓	✓	✓
Constant	0.121***	0.129***	0.227***
R^2	0.845***	0.846***	0.847***

~p<.10; *p<.05; **p<.01; ***p<.001. Outcome is standardized (z-scored) within grades and years.

Appendix A: Unpacking Teacher Attrition

Figure 7 above focused on retention differences between TFA and non-TFA teachers. The full-model results are presented here to highlight specific teacher characteristics that are associated with both TFA membership and general teacher attrition (see Table 6 below). Model 1, which provides unadjusted odds ratios, indicates that the odds that TFA teachers returned for year three were only one-quarter those of their non-TFA novice colleagues ($p<.001$). Model 2 then introduces the teacher background characteristics, which narrows the odds gap somewhat between TFA and other teachers. Specifically, the adjusted odds that a TFA teacher returned for year three are now roughly one-third those of non-TFA teachers ($p<.001$). Note also that the odds of returning were far lower for Asian compared to white teachers, regardless of TFA status or other background characteristics.

Teachers with regular teaching certificates had adjusted odds of returning that were roughly 45% greater than teachers who possessed temporary certificates (or had unknown certification status). Many uncertified teachers were forced to leave due to State regulations, while many others left on their own accord. Teachers who had obtained their undergraduate degree from a Florida college or university had adjusted odds of returning that were 43% greater than teachers who had obtained degrees elsewhere. Importantly, these teacher traits were also associated with TFA membership: TFA teachers were less likely to be certified, and were more likely to have attended an undergraduate institution outside of Florida. This helps us to understand the narrowing of the TFA/non-TFA odds ratios from Model 1 to Model 2. When we statistically equate TFA and non-TFA teachers, their retention rates begin to converge.

These odds ratios are then re-estimated with school fixed-effects in Model 3, which compares retention rates among TFA and other teachers in the same schools, thereby removing unmeasured differences across schools that might influence retention rates. Doing so reduces a substantial portion of the TFA/non-TFA retention disparity, with the odds of TFA teachers returning for year three now approaching half those of non-TFA teachers ($p<.001$). The increased departure rates among Asian teachers hold here in this model as well, as do the higher retention rates among those with regular teaching certificates and degrees from Florida colleges and universities. Note, however, that in Model 3 students who attended colleges with higher average test scores were somewhat less likely to return for a third year in DCPS, even compared to other teachers in the same school and adjusting for teacher background characteristics.

Specifically, each one-standard deviation increase in college-average test scores was associated with an 11.3% decrease in the odds a teacher would remain in the district beyond year two.

Table 6. Unpacking Teacher Retention: Odds of Starting Year Three of Teaching in DCPS among Novice Teachers (n=1,795 teachers within 165 schools)

	Model 1: Unadjusted	Model 2: Adjusted for Teacher Characteristics	Model 3: Adjusted for Teacher Characteristics, Within Schools
Teacher Characteristics			
TFA	**0.268*****	**0.393*****	**0.421*****
Female		1.192	1.193
Age at Start (years)		0.993	1.002
Asian[1]		0.397**	0.397*
Black		1.052	1.111
Hispanic		0.775	0.818
Other Race/Ethnicity		0.758	0.768
Core Academic Teacher[2]		0.873	0.906
Regular Certification[3]		1.454**	1.433*
Ed. Undergrad. Degree		1.167	1.151
Florida Undergrad. Degree		1.434**	1.444**
College's Avg. Test Score[4]		0.908	0.887~
College's Acceptance Rate		1.003	1.002
Intercept	1.754***	1.127	1.265

~p<.10; *p<.05; **p<.01; ***p<.001 with robust standard errors. Estimates are odds ratios.
[1] White teachers are the statistical comparison group for all racial/ethnic groups.
[2] Includes regular K-6 classroom teachers; grade 7-12 mathematics, English, Social Studies, Science, ESL and Foreign Language Teachers. Compared to all other teachers.
[3] Compared to teachers with temporary or unknown certifications
[4] Measure is standardized (z-scored; M=0, SD=1)

Appendix B: Data and Methods

Analytic Samples

These analyses employ student- and teacher-level administrative data supplied by the Duval County Public Schools. The models use a base sample of students who were in grades 3-10 at any point during the 2007-2008 through 2013-2014 school years (although no mathematics test scores were available for grades 9 and 10 beginning with the 2010-2011 school year). These base samples include 415,573 measurements within 147,651 students for mathematics and 485,986 measurements within 152,560 students for reading. Of these students, 42.7% were black, 8.4% Hispanic, 4.5% Asian, 4% Native/American or multiracial, with the remaining 40.4% of students white. Just over half (51.3%) received free/reduced-price lunches, 13% were receiving special education services, 7.9% were English language learners, and 49.5% were female.

The teacher samples included 5,242 teachers who instructed mathematics in a tested grade during this period, including 101 TFA teachers, representing 1.9% of all mathematics teachers. The reading base sample included 6,215 teachers, including 137 TFA teachers (2.2% of all reading teachers). Both samples were over 80% female, two-thirds white, with a combined average of roughly 11 years of teaching experience. Approximately three-quarters of teachers held regular teacher certifications, and roughly two out of three majored in education as undergraduates.

Outcomes

The outcome for Part 1 of these analyses was a dichotomous indicator of whether a teacher began a third year of service with DCPS (1=yes, 0=no). The outcomes for Part 2, the teacher effectiveness models, were FCAT mathematics and reading standardized test scores. As noted below, different analytic models used these scores in different ways. The central models employed FCAT scores as outcomes but included prior-year scores (and their quadratics) as covariates within an analysis of covariance (ANCOVA) framework. The within-student models simply used the FCAT scores as outcomes. All test scores are standardized (z-scored) within subject, grade, and year. Using different test scores depending on the model has implications for the sample sizes available for each analytic approach, as noted below. Given the relatively large sample sizes employed in these analyses, wherever possible results are indicated in effect size

(standard deviation) units, and an effort is made to distinguish statistically significant from substantively important estimates.

Accounting for the Influence of Multiple Teachers per Grade and Subject

Previous research on teacher effects has generally ignored the fact that multiple teachers often influence a single student's academic development, even within the same subject and grade. One cause is student mobility, both across teachers within schools and between schools. Another is teacher mobility, due to mid-year resignations, late hires, and mid-year transfers. But the most common source of multiple teacher influences is related to instructional practices such as team teaching and the use of academic support specialists. In any given year between the 2007-2008 and 2013-2014 school years, 72.5% of DCPS students in a tested grade and year had a single teacher for mathematics. With reading, due to additional support from reading and ELL specialists, only 54% of students had a single teacher.

To address this issue, students who had more than one teacher per subject per grade were present in the data files once for each distinct teacher. Fortunately, DCPS collects data twice during the academic year on which teachers are teaching which students in all subject areas, including academic support classes. Using these data, a weight was constructed (and used in all multivariate analyses) that maintains both the sample size and the proportional impact of each student in both mathematics and reading. An assumption is that when multiple teachers were present for equal amounts of the academic year, each teacher contributed equally to a given student's academic development. Although clearly not wholly defensible, no other data or available information suggests how to apportion appropriate responsibility in the presence of multiple teachers per academic year.

Analytic Models

Teacher retention. The analyses of retention differences between TFA and non-TFA teachers entailed several logistic regression models. These models, which estimate the odds that a novice teacher returned to DCPS for the start of a third year of service, are defined as:

$$(1) \qquad \eta_{ij} = \beta_{0j} + \beta_{.j} X_{ij} + e_{ij}$$

where η_{ij} represents the log-odds of teacher *i* in school *j* returning to DCPS to start their third year of service. A vector of teacher-level measures (X_{ij}) for teacher *i* in school *j* include TFA status, female, and an indicator of whether the teacher taught core academic classes (versus special education or elective courses). Other teacher background characteristics included whether the teacher had temporary or unknown teacher certification, had majored in education as an undergraduate, and had obtained his/her undergraduate degree from a Florida college or university. Other continuous measures indicating the type of college or university each teacher attended included the college's average test scores (ACT for ACT-dominant colleges, SAT for SAT dominant-colleges, z-scored), and the college's acceptance rate.[19] Teacher race/ethnicity is accounted for with a series of dummy-coded indicators (black, Hispanic, Asian, Native American or multiracial) with whites used as the uncoded comparison group. Models 1 and 2 for the teacher retention analyses cluster the standard errors for schools. In Model 3 school fixed-effects are incorporated.

Teachers are linked with the first school to which they were assigned, which is appropriate given that teachers in DCPS are not permitted to change schools within their first three years. The teacher sample includes a small number of itinerant teachers who served multiple schools per week, such as those who taught art and music or special student populations. These teachers were nested in a single school category.

Student academic performance. Ideally, these analyses would nest time within students, who would be cross-classified within teachers and schools. However, as noted above, DCPS students are not so neatly grouped within individual teachers. Instead, borrowing in part from Kane et al. (2006), student academic performance is estimated as:

$$(2) \quad A_{ity} = \beta_g X_{it} + \gamma_g \bar{X}^c_{ity} + \delta W_{ity} + \theta_{ity} + \pi_{gt} + \varepsilon_{ity}$$

where A_{ity} represents the mathematics or reading test score for student *i* in teacher *t* in year *y*, and X_{it} indicates the characteristics of student *i* in year *t* (which do not vary across *t* within *y*), including the number of school absences in year *t*, female, whether the student changed schools during the academic year, and free/reduced-price lunch, special education, and ELL status

[19] Data on college/university characteristics were obtained from the Integrated Postsecondary Education Data Center (IPEDS), sponsored by the National Center for Education Statistics, U.S. Department of Education. Data are available at: http://nces.ed.gov/ipeds/

(1=yes, 0=no). Race/ethnicity is accounted for with a series of dummy-coded indicators (black, Hispanic, Asian, other [Native American and multiracial]) with whites used as the uncoded comparison group. Also included is the same-subject prior year's test score, as well as a prior-year test score quadratic (squared) term to account for potential non-linear associations between initial status and subsequent academic growth (cubic terms were non-significant in all models). Classroom-level aggregate indicators are represented by $\bar{X}^c$, and include classroom-average percent black student enrollments and percent Hispanic student enrollments, as well as percent of free/reduced-price lunch, special education and ELL students.

Teacher characteristics are represented by W_{ity} and include TFA status, whether the teacher had a regular teaching certificate, and whether the teacher majored in education as an undergraduate (1=yes, 0=no). The mathematics models also included an indicator of whether the teacher had an undergraduate degree in mathematics or a mathematics-heavy field, including math education, physics or physics education, computer science, engineering, economics, accounting, or statistics. Also included are years of teaching experience (centered around its mean) and its quadratic. The student/teacher/year-specific weight (θ_{ity}) accounts for the fact that students are sometimes nested within multiple teachers per grade per year. A fixed effect for student *i*'s grade in year *t* is represented by π_{gt}. The standard errors for all models are clustered to account for the fact that multiple measurements are nested within students over time, and also to account for the nesting of multiple students within grades and years. An important limitation of the ANCOVA approach is that student achievement is only estimated for years in which the student had an available test score for the prior year. In addition to lost years due to missing test scores, this requirement also precludes the modeling of third-grade academic growth, as second-grade test scores are not available.

A second series of models also incorporates school fixed effects. A third series of models includes student fixed effects, eliminating prior-year achievement as a covariate. Rather, achievement is compared within the same student over time as a function of exposure to a TFA teacher. In addition to removing all unmeasured differences across students, this approach also permits the modeling of third-grade achievement. All models tested for interactions between TFA status and all other covariates. None were found to be significant, and all were removed from the analyses presented here.

References

Boyd, D., Grossman, P., Hammerness, K., Lankford, H., Loeb, S., Rondeldt, M., & Wyckoff, J. (2012). Recruiting effective math teachers: Evidence from New York City. *American Educational Research Journal, 49*(6), 1008-1047.

Clark, M.A., Chiang, H.S., Silva, T., McConnel, S., Sonnenfeld, K., Erbe, A., & Puma, M. (2013). *The effectiveness of secondary math teachers from Teach for America and teaching fellows programs* (NCEE 2013-4015). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education.

Darling-Hammond, L., Holtzman, D.J., Gatlin, S.J., & Heilig, J.V. (2005). Does teacher preparation matter? Evidence about teacher certification, Teach for America, and teacher effectiveness. *Education Policy Analysis Archives, 13*(42).

Decker, P.T., Mayer, D.P., & Glazerman, S. (2004). *The effects of Teach for America on students: Findings from a national evaluation*. Princeton, NJ: Mathematica Policy Research, Inc.

Goldhaber, D., Gross, B., & Player, D. (2007). *Are public schools really losing their ‘‘best’’? Assessing the career transitions of teachers and their implications for the quality of the teacher workforce.* Washington, DC: National Center for Analysis of Longitudinal Data in Education Research, Institute of Education Sciences, U.S. Department of Education.

Hanushek, E.A., Kain, J.F., & Rivkin, S.G. (2004). Why public schools lose teachers. *The Journal of Human Resources, 39*(2), 326-354.

Harris, D.N., & Adams, S.J. (2007). Understanding the level and causes of teacher turnover: A comparison with other professions. *Economics of Education Review, 26*(3), 325-337.

Henke, R.R., & Zahn, L. (2001). *Attrition of new teachers among recent college graduates.* Washington, DC, National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Henry, G.T., Thompson, C.L., Bastian, K.C., Fortner, C.K., Kershaw, D.C., Purtell, K.M., & Zulli, R.A. (2010). *Portal Report: Teacher preparation and student test scores in North Carolina.* Chapel Hill, NC: Carolina Institute for Public Policy.

Ingersoll, R.M. (2003). *Is there really a teacher shortage?* Center for the Study of Teaching and Policy, University of Washington (Document R-03-4).

Kane, T.J., Rockoff, J.E., & Staiger, D.O. (2006). *What does certification tell us about teacher effectiveness? Evidence from New York City*. Cambridge, MA: National Bureau of Economic Research (Working paper 12155).

Murnane, R. J., & Olsen, R. J. (1990). The effect of salaries and opportunity costs on length of stay in teaching: Evidence from North Carolina. *Journal of Human Resources, 25,* 106–124.

Murnane, R. J., & Olsen, R. J. (1989). The effects of salaries and opportunity costs on duration in teaching: Evidence from Michigan. *Review of Economics and Statistics, 71,* 347–352.

Noell, G.H. & Gansle, K.A. (2009). *Teach for America teachers' contribution to student.* Washington, DC: National Council on Teacher Quality.

Podgursky, M., Monroe, R., & Watson, D. (2004). The academic quality of public school teachers: an analysis of entry and exit behavior. *Economics of Education Review, 23*(5), 507–518.

Rivkin, S. G., Hanushek, E.A., & Kain, J.F. (2005). Teachers, schools, and academic achievement. *Econometrica,* 73(2): 417-458.

Ronfeldt, M., Loeb, S., & Wyckoff, J. (2013). How teacher turnover harms student achievement. *American Educational Research Journal*, *50*(1), 4-36.

Turner, H.M., Goodman, D., Adachi, E., Brite, J., & Decker, L.E. (2012). *Evaluation of Teach for American in Texas schools*. San Antonio, TX: Edvance Research, Inc.

Ware, A., LaTurner, R.J., Parosns, J., Okulicz-Kozaryn, A., Garland, M., & Klopfenstein, K. (2011). *Teacher Preparation Programs and Teach for America Research Study.* Dallas, TX: Education Research Center.