# Alternative Certification in the Long Run: Student Achievement, Teacher Retention and the Distribution of Teacher Quality in New York City

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A large number of school districts still struggle to hire qualified teachers, especially in subjects such as special education, math and science. However, over the last ten years the landscape of teacher supply has been dramatically altered by the substitution of alternatively certified teachers for unlicensed teachers in many school districts (Feistritzer, 2008). An increasing body of research has described the characteristics of alternatively certified teachers and compared their effectiveness on value-added outcomes for students and their attrition to the unlicensed teachers they replaced as well as to teachers from other pathways (Boyd et al., 2006, 2008, 2009a, 2009b; Constantine et al., 2009; Decker et al., 2004; Feistritzer, 2008; Grossman and Loeb, 2008; Kane et al., 2009; Xu et al., 2009). Alternatively certified teachers disproportionately teach in high needs schools and subjects. While results vary somewhat, these studies find that the students of teachers who enter teacher through highly-selective alternative routes experience better achievement gains than the students of the unlicensed teachers they replaced; comparable, or in some cases somewhat better, math achievement gains than the students of teachers from traditional preparation pathways; and comparable, or in some cases somewhat worse, achievement gains in English language arts than the students of teachers from traditional preparation pathways. This research also finds that alternatively certified teachers are more likely to leave their initial schools and districts than traditionally prepared teachers.

Because the widespread hiring of alternatively certified teachers is a relatively recent phenomenon, most of this research focuses on novice teachers and none of it examines the effects of teachers with more than three years of experience. Thus, our understanding of the longer-run effects of the introduction of alternative routes, particularly highly-selective alternative routes, is weak. For this study, we employ a detailed database of all teachers in New York City from 2000-01 through 2007-08 to explore the long run implications of alternative certification. New York City is a good place for such an analysis, as the school district has employed large numbers of alternatively certified teachers since fall 2001 when New York City hired its first cohort of more than 1000 New York City Teaching Fellows (NYCTF) and about 100 Teacher for America (TFA) teachers. Hiring of alternatively certified teachers grew so that by 2003-04 nearly 2500 NYCTF teachers were hired in one year, constituting more than a quarter of all new hires. There are now a large group of alternatively certified teachers who began their teaching careers between 5 and 8 years ago. Data on these teachers and all other

teachers in the district allow us to explore a number of research questions that inform the understanding of the long-run implications of alternatively certified teachers.

To address this gap in our understanding, in this preliminary analysis we examine three broad research questions:

- How do the characteristics and careers of teachers from different pathways differ?
- What are the effects of teachers entering through different pathways on student achievement and how has this changed over time?
- To what extent does the leaving behavior of more or less effective teachers differ across pathways?

Each of these questions has a number of sub-questions and requires multiple approaches which we describe below. We note here, and will repeat elsewhere, that this analysis is based on data through 2008. We are in the process of extending this analysis to 2010 and exploring additional analyses to insure the robustness of our findings. With these caveats in mind, we find:

- The role of the New York City Teaching Fellows (NYCTF) has changed substantially since its inception in 2001 from supplying mostly Childhood Education teachers to a focus on the difficult to staff subjects of special education, mathematics, English as a Second Language and science. In many respects NYCTF has served as the supplier of last resort for NYC teaching vacancies.
- The NYCTF program recruits the largest percentage of teachers with higher certification scores, higher SAT scores and who attend more competitive colleges.
- We do not find meaningful student achievement value-added differences in the returns to experience by pathway.
- Pathway effects have been fairly consistent over time with the exception that the students of NYCTF teachers are experiencing somewhat smaller gains in math over time but somewhat larger gains in ELA relative to their peers from other pathways.
- NYCTF teachers transfer and exit somewhat more than traditional preparation teachers; TFA teachers transfer and exit substantially more than either NYCTF or traditional preparation teachers, except after their first year of teaching.
- Over time NYCTF teachers have become somewhat more likely to transfer following their first and second years of teaching and more likely to exit teaching in NYC following their first year.
- Some preliminary evidence suggests that it is the NYCTF teachers with low value-added who are more likely to exit than their higher value-added peers, although high value-

added NYCTF teachers still appear more likely to exit than high value-added teachers from traditional preparation programs.

## BACKGROUND

In the years prior to 2000, the environment for teacher recruitment and retention in New York City was bleak. Much of New York City's difficulty in teacher recruitment is evidenced by the statistic that from at least as early as 1995–96 through 2001–02 roughly half of all new teachers were temporarily licensed (uncertified). Other measures of teacher qualifications were also notably weak. For example, 25% of newly hired teachers in 1999–2000 had failed the New York State certification exam on the first taking, 26% had attended undergraduate institutions rated by Barrons as uncompetitive, and, on average, newly hired teachers had average math and verbal SAT scores of 466 and 477, respectively.

New York City also had a weak record of teacher retention, especially in the most challenging schools and among their most qualified teachers. For example, between 1996 and 2002 only 20% of new teachers in the top quartile on the certification exam left high-achieving schools following their first year, but 34% of those teaching in low-achieving schools left after one year. By contrast, 14% of teachers in the *bottom* quartile on the certification exam left high-achieving schools after one year, and 17% left low-achieving schools.[1]

There were a number of reforms beginning in 2000 that dramatically changed the recruitment and retention of teachers. Reform efforts such as improving teacher compensation, especially for entering teachers, improving school leadership, attempting to enhance both financial incentives and supports for teachers, and making human resource processes more transparent and tied to measures of performance may all contribute to improving the quality of teaching in NYC. However, arguably one of the more dramatic changes was the series of reforms in policy and practice that led to the development of the New York City Teaching Fellows (NYCTF). In short, NYCDOE built the NYCTF program into a successful source for

[1] D. Boyd, H. Lankford, S. Loeb, and J. Wyckoff, "Explaining the Short Careers of High-Achieving Teachers in Schools with Low-Performing Students," *American Economic Review Proceedings* 95 no. 2 (2005): 166–171.

recruiting between 20 and 30 percent of all new teachers. We explore some of the implications of the development of NYCTF on teaching and student achievement in NYC.

**Data.** For this analysis we employ various data files from NYCDOE and NYSED:

- individual-level administrative data characterizing the backgrounds, qualifications, and career histories of all NYC public school teachers (2000-2008);
- student-level achievement test results for grades 3-8 in math and ELA linked to the teaches who taught these students (2000-2008);
- administrative and other data characterizing the schools in which teachers teach (2000-2008);
- data on the first program path of teachers (2000-2008);

All are linked at the individual teacher level.

## PATHWAYS INTO TEACHING IN NEW YORK CITY

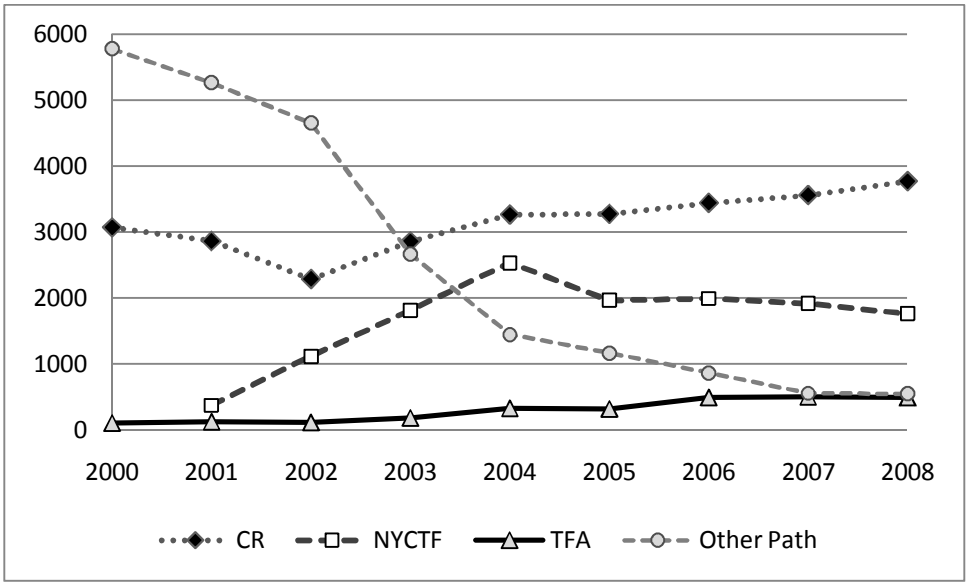
***How do the characteristics and careers of teachers from different pathways differ?***

A series of changes in policy and practice had a substantial effect on teacher recruitment in NYC. In 1998 the New York State Regents passed regulations ending the use of temporary license teachers by Fall of 2003. At that time the Regents also allowed for the creation of alternative certification pathways as routes to certification in NYS. In response NYCDOE NYCDOE developed and implemented the New York City Teaching Fellows program. As shown in Figure 1, the number of temporary license first-year teachers, which comprised 5000 of the "Other Path" teachers in 2000 fell to virtually zero by 2005. The New York City Teaching Fellows program NYCTF) was created in 2000 and by 2004 supplied more than 2,500 teachers. As shown, there was also meaningful increase in first-year teachers coming from traditional teacher preparation programs (CR) and a smaller increase from Teach for America (TFA) over the same period.

The changes in the pathways through which teachers were recruited had important implications for the attributes of teachers. We focus on a few of the more striking differences. The appendix includes more detailed tabulations.

**Certification Area.** Among the most remarkable changes has been the evolution of the recruitment goals of NYCTF program over time. At its inception the NYCTF program was dominated by teachers whose certification was in Childhood Education (Figure 2). Sixty to seventy percent of NYCTF teachers where certified in Childhood Education which comprised about 30 percent of all teachers being hired by NYC with this certification area (Appendix Table

**Figure 1. Number of First-Year Teachers by Pathway and Year**




Note: Other Path includes Modified Teaching Licensed, Transitional B Licensed, Temporary Licensed, and Individual Evaluation Teachers.

A7). However, this quickly changed so that by 2006 fewer than 15 percent of all NYCTF teachers were Childhood Education certified.

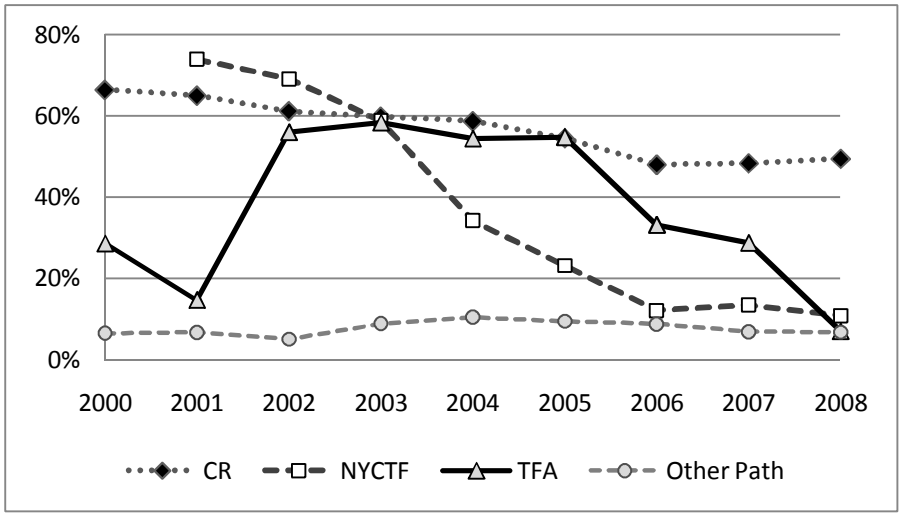
The NYCTF program quickly shifted to focus its efforts on supplying teachers in key shortage areas, such as mathematics, science, special education and English as a second language. As shown in Figures 3a-d, NYCTF became the dominant source of supply for teachers in each of these certification areas. By 2006 NYCTF was supplying about 60 percent of all new math certified teachers, 40 percent of teachers certified in science, 50 percent of special education teachers, and 50 percent of ESL teachers. In many respects, NYCTF has become the supplier of last resort to difficult-to-staff subjects in NYC.

As might be expected, this change in teacher certification was accompanied by a change in the grade level of the schools in which NYCTF teachers taught. In 2002, 68 percent of NYCTF teachers were assigned to elementary schools; by 2008 that figure had fallen to 27 percent. The decline in elementary teacher assignments is roughly matched by equal increases in assignments to middle and high schools. Teachers from traditional teacher preparation programs

are disproportionately assigned to elementary schools (57 percent in 2008) while TFA teachers are almost exclusively assigned to elementary and middle schools.

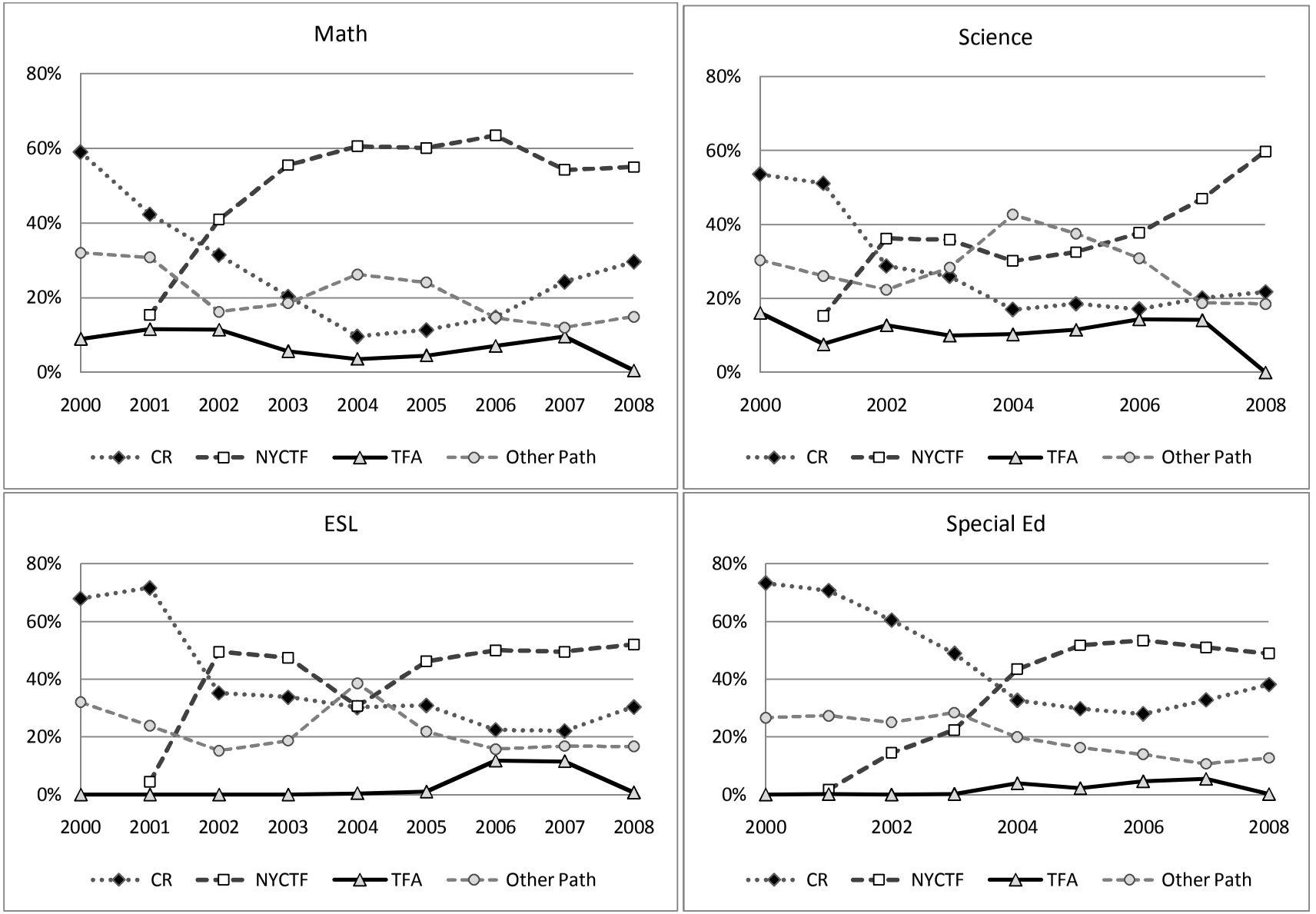
**Academic Ability**. The NYCTF program has consistently recruited teachers with strong credentials as measured by tests of academic ability (Appendix Table A6) and the competitiveness of their undergraduate colleges (Appendix Table A1). NYCTF recruits teachers who on average score consistently better than teachers entering NYC public schools through the traditional preparation programs (college recommended) or through the "Other" pathways group and consistently somewhat worse than those entering through TFA. This pattern is replicated in the Barron's rankings of the undergraduate colleges of teachers. About a third of NYCTF teachers graduated from the most competitive colleges, while about 12 percent of CR teachers and more than 60 percent of TFA did so (Appendix Table A1).

**Figure 2. Teachers Certified in Childhood by Pathway and Year**




**School Placements**. The first teaching assignment of teachers from different pathways varies substantially, as might be expected from the differing goals associated with the pathways. NYCTF and TFA teachers are much more likely to teach students who are poor, Black or Hispanic, have been suspended from school, and who have lower math and ELA achievement test scores (Appendix Table A17). For example, in 2008, the students of an average first-year NYCTF teachers in grades 3-8 scored 0.25 standard deviations below those of the average

**Figures 3a-d. Teachers Certified by Area, Pathway and Year**



traditional teacher preparation teachers and about 0.13 standard deviations above the students entering the average first-year TFA teacher's classroom. While there is some variation, similar patterns exist across other measures and over time. In short, NYCTF and TFA teachers have consistently been assigned to what appear to be more challenging classrooms.

## PATHWAYS AND STUDENT ACHIEVMENT

***What are the effects of teachers entering through different pathways on student achievement and how has this changed over time?***

The second part of this study examines the effectiveness of teachers from different pathways, asking what are the effects of teachers entering through different pathways on student achievement and how has this changed over time? There are several components to this analysis. First, the base model examines the average effects of teachers from different pathways over the full time-period of our data. In this base model, the standardized achievement level (test score) of a student is modeled as in equation (1).

$$A_{ijst} = \beta_0 + \beta_1 A_{ijs(t-1)} + \beta_2 A^2_{ijs(t-1)} + X_{it}\beta_3 + C_{ijst}\beta_4 + T_{jst}\beta_5 + \Pi_j + \nu_s + \varepsilon_{ijst} \quad (1)$$

Here, the achievement (*A*) in math (ELA) of student *i* in year *t* with teacher *j* in school *s* is a function of his or her prior achievement in both ELA and math and of prior achievement in both subjects squared, time-varying and fixed student characteristics (*X*), characteristics of the classroom (*C*), characteristics of the teacher (*T*), indicator variables (fixed effect) for the pathway by which the teacher entered teaching in NYC ($\Pi$), a fixed-effect for the school ($\upsilon$), and a random error term ($\varepsilon$).

Student characteristics include gender, race/ethnicity, poverty status, days absent during the prior year, and suspensions in the prior year. The aggregate classroom (teacher by grade by school by year) student characteristics include race/ethnicity, poverty status, average attendance in the prior year, average suspensions in the prior year, average student test scores in the prior year, and the standard deviation of student test scores in the prior year. Teaching experience is measured by dummy variables for each year of teaching from the first year through the twentieth and then an additional dummy variable for experience greater than twenty years. In addition, the model includes fixed effects for years, grades, and schools.

All teachers in this analysis are certified through one of the following pathways: college recommended, Teach for America, New York City Teaching Fellows, independent evaluation, Trans B license, temporary license, or pathway unknown. All analyses include teachers from every pathway, but our description of the findings focuses on the first three pathways: college recommended (CR), Teach for America (TFA), and the New York City Teaching Fellows (NYCTF). The reference group for each analysis is NYCTF so the results describe the effects of CR and TFA relative to NYCTF.

The standard errors are clustered at the teacher level to account for the fact that teacher pathway is a teacher-level variable. This model controls for all the attributes of students that typically remain constant from one year to the next, such as parental support and home environment. It also controls for all the characteristics of schools that do not change over the time period by including a school fixed effect. We estimated models separately for math and for English languages arts. We also estimated models separately for elementary grades (grades four and five) and middle school grades (grades sixth through eight) as well as a model that pools all grades.

We experimented with a large number of other models that make alternative assumptions regarding the determinants of student achievement, including the use of student fixed effects rather than school fixed effects, and additional lags in prior achievement. Unless noted, the results presented do not differ in any meaningful way from these alternative specifications.

In general we find that mean value-added differences among pathways mirror prior work--NYCTF and traditional preparation produce very similar results; TFA produces somewhat larger achievement gains in math.

***How does the effect of experience by pathway change over time, especially for more experienced teachers?***

To investigate whether there are differential effects over time and pathway, we augment the base model described above with pathway indicator variables interacted with experience indicator variables. Because the use of these interactions incorporate both returns to experience and the changing composition of the workforce as some teachers exit, we also estimate models that examine the returns to experience for teachers with 3 or more years of experience and 5 or

more years of experience. This has the effect of holding such attrition constant. The results of these analyses are not included in the body of this paper because nearly all of the results are insignificant. For math achievement, there are not significant differential returns to experience by pathway. However, for ELA, there is some evidence that middle school NYCTF gain in effectiveness relative to CR for later years of experience (4 and 5 years). These ELA results are statistically significant and of a roughly the same size as the difference between the average first and second year teacher (effect sizes of 0.03 to 0.06, (the results are in Appendix table A18). We consider these worthy of attention.

***How has the value-added of pathways changed over time?***

We assess how the relative effect of pathways may have changed over the period 2000-2008 in two ways: by cohorts and by calendar years. First, we examine the effects of cohorts of teachers and how these effects change over time. Here we identify cohorts of teachers by the year in which they began teaching. We then interact pathways and cohorts to get a sense of whether, for example, the teachers recruited in 2003 might differ in effectiveness from those recruited in 2007. We employ two measures of cohorts, a continuous measure and a measure that groups cohorts into early, middle and late groupings (early: 2000-2002, middle: 2003-2005, and late: 2006-2008).

Specifications 1 (continuous) and 2 (groupings) in Table 1 capture how the math effectiveness of pathway cohorts has changed over time. The continuous cohort*pathway effects capture the change in effectiveness for each successive cohort of a given pathway. Over time, cohorts of CR and TFA have been gaining effectiveness, relative to NYCTF, although again, the effects are small in magnitude in any given year. Over the 9 years of data studied, however, CR has gained 0.06 standard deviations relative to NYCTF. The same pattern can be seen in specification 2 where cohorts are designated by the groupings. Although not statistically significant, the coefficient estimates for math suggest that NYCTF teachers have become slightly less effective over time (both early and middle cohort estimates are about 0.013). It is also the case that NYCTF cohorts appear less effective than either CR or TFA cohorts. These results appear to be driven almost entirely by differences that exist at the middle school level, estimates for which are shown in Appendix Table A17).

**Table 1: The Effects of Pathways over Time and Cohorts**

| | MATH | | | | ELA | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| pathway: TransB | 0.0533 | | -0.0524 | | 0.0280 | | 0.1030 | |
| pathway: IE | -0.0313*** | | -0.0394*** | | 0.0175** | | 0.0543*** | |
| pathway: CR | -0.0165* | | -0.0331** | | 0.0195*** | | 0.0617*** | |
| pathway: TFA | 0.0032 | | -0.0197 | | 0.0066 | | 0.0329* | |
| pathway: unknown | -0.0177 | | -0.0337** | | 0.0195** | | 0.0552*** | |
| pathway: temp license | -0.0310*** | | -0.0536*** | | -0.0043 | | 0.0369*** | |
| continuous cohort | -0.0051** | | | | 0.0014 | | | |
| cont. cohort * TransB | -0.0135 | | | | -0.0028 | | | |
| cont. cohort * CR | 0.0072*** | | | | -0.0034 | | | |
| cont. cohort * IE | 0.0044 | | | | -0.0055* | | | |
| cont. cohort * TFA | 0.0085* | | | | -0.0009 | | | |
| cont. cohort * unknown | -0.0009 | | | | -0.0037 | | | |
| cont. cohort * temp. | 0.0054 | | | | 0.0091 | | | |
| early cohort * CR | | 0.0092 | | | | 0.0094 | | |
| early cohort * NYCTF | | 0.0129 | | | | -0.0031 | | |
| early cohort * TFA | | 0.0308* | | | | -0.0044 | | |
| middle cohort * CR | | 0.0176* | | | | 0.0011 | | |
| middle cohort * NYCTF | | 0.0125 | | | | -0.0079 | | |
| middle cohort * TFA | | 0.0423** | | | | 0.0006 | | |
| late cohort * CR | | 0.0233** | | | | 0.0012 | | |
| late cohort * TFA | | 0.0487*** | | | | -0.0012 | | |
| continuous year | | | -0.0064*** | | | | 0.0100*** | |
| year * TransB | | | 0.0056 | | | | -0.0127 | |
| year * IE | | | 0.0029 | | | | -0.0074*** | |
| year * CR | | | 0.0056*** | | | | -0.0078*** | |
| year * TFA | | | 0.0078** | | | | -0.0039 | |
| year * unknown | | | 0.0025 | | | | -0.0067*** | |
| year * temp. license | | | 0.0064*** | | | | -0.0048*** | |
| early year * CR | | | | 0.0114* | | | | -0.0141*** |
| early year * NYCTF | | | | -0.0101 | | | | -0.0394*** |
| early year * TFA | | | | 0.0330* | | | | -0.0278** |
| middle year * CR | | | | 0.0181*** | | | | -0.0262*** |
| middle year * NYCTF | | | | 0.0225*** | | | | -0.0450*** |
| middle year * TFA | | | | 0.0368*** | | | | -0.0380*** |
| late year * CR | | | | 0.0123* | | | | 0.0000 |
| late year * TFA | | | | 0.0460*** | | | | 0.0021 |

Specifications 5 and 6 show the cohort analyses for ELA teachers. There are no significant differential effects by pathways over the cohorts, although when specification 5 is estimated separately for elementary and middle schools, CR and TFA become statistically less effective in elementary schools, relative to NYCTF (the results are in Appendix Table A19). Specification 6 also shows no significant differences in the effectiveness of pathways by cohorts.

An alternative measure of the effect of time is to include an interaction between each pathway and a measure of the years, either a time trend or a grouping of years (early: 2000-2002, middle: 2003-2005, and late: 2006-2008) to our base model. This measure includes the mean effect of all teachers currently teaching in that year regardless of experience. This measure allows us to examine how the mean effectiveness of teachers from different pathways differs at varying points in time.

Specifications 3 and 4 show how the average math effectiveness of each pathway has changed over time. The gains in CR and TFA are similar in magnitude in both the cohort and year analyses, which indicates that most of the improvements in CR and TFA, relative to NYCTF, are due to changes in first year teachers entering each pathway, rather than differential attrition.

Even though we see few differences by pathway in cohorts of first year ELA teachers, specifications 7 and 8 show that there are significant differences in the effectiveness of pathways over time. On average NYCTF teachers have been gaining in effectiveness compared to CR. TFA has not been gaining relative to NYCTF (unlike the math results). Again, all of these effects are relatively small in magnitude. Specification 8 shows that early and middle year CR, TFA, and NYCTF are less effective than late year NYCTF. This finding is consistent with the notion that NYCTF have been becoming more effective over time in ELA.

## PATHWAYS AND TEACHER RETENTION

### *How does teacher attrition differ by pathway and over time?*

The retention analyses are based on the decisions of all New York City public school teachers who were in their first year of teaching between 1999-2000 and 2007-2008, a population of 72,925 teachers.[2] We examine teachers' decisions to stay at the same school, transfer schools within NYCDOE, or exit teaching in NYCDOE. We examine teachers' decisions after each of their first three years of teaching conditional on their prior year decisions. Since our data currently run through the 2007-08 year, our analysis for first-year retention

[2] Our analysis is limited to teachers for whom we observe their first year of teaching in New York City to reduce the selection bias associated with employing teachers whose early careers we do not observe, some of whom are no longer in the NYC public schools.

decisions ends with the entering cohort of 2007. Similarly, second and third-year retention decisions conclude with the cohorts of 2006 and 2005 respectively. These analyses will extend an additional two years once we integrate the newly acquired data.

We estimate multinomial logit models with school fixed effects, controlling for pathway.[3] We include school fixed effects to control for the fact that teachers are not randomly distributed across schools, and teachers' decisions to transfer or exit are likely a function of their initial placements. We follow this analysis of mean pathway effects with analyses to test whether these relationships change over time. In particular, we are interested in whether more recent cohorts (as defined by a teacher's first year of teaching) of teachers have behaved differently than earlier cohorts.

Before turning to the results of our multinomial logit regressions, Table 2 presents descriptive statistics of the retention decisions of all teachers by year of experience unconditioned by school fixed effects. The Year 1 column describes all teachers' decisions after their first year of teaching. The Year 2 (Year 3) column describes teachers' decisions after their second (third) year of teaching for those teachers who stayed in the same school after their first (first and second) year(s) of teaching. As expected, by the third year of teaching teachers from traditional teacher preparation programs on average persist at higher rates, both in their original school assignments and in NYC than either NYCTF or TFA teachers. However, TFA teachers are substantially more likely to exit teaching in NYC following years 2 and 3 than either NYCTF or traditional preparation teachers. These patterns are not unexpected given two-year commitment of TFA members and the arguably more challenging working environments facing NYCTF and TFA teachers.

Table 3 presents multinomial logit analyses examining teacher retention patterns by pathways where teachers are compared to teachers from other pathways *in their own school*. For simplicity, we only present the results for NYCTF and TFA. The omitted group is CR teachers, so the odds ratios represent the likelihood of NYCTF and TFA teachers to transfer or exit relative to CR teachers. NYCTF teachers were significantly more likely to transfer than their CR peers. For example, they were approximately 50 percent more likely to transfer after their first

[3] The pathways are college recommended (CR), New York City Teaching Fellows (NYCTF), Teach for America (TFA), individual evaluation, temporary license, and other/unknown.

year. In addition, they were also more likely to exit after their second or third year, but they were less likely to exit after their first year. The TFA results are more striking. Although TFA teachers were less likely to transfer or exit than their same school CR colleagues after their first year, they were more likely to transfer and exit after their second or third year. In fact, they were almost 11 times as likely to exit after their second year than CR teachers.

**Table 2. Cumulative Retention Decisions by Pathway and Years of Experience**

| | After year 1 | After year 2 | After year 3 |
|---|---|---|---|
| CR | | | |
| Same school | 0.82 | 0.71 | 0.62 |
| Transferred | 0.08 | 0.13 | 0.17 |
| Exit | 0.09 | 0.15 | 0.20 |
| NYCTF | | | |
| Same school | 0.78 | 0.57 | 0.42 |
| Transferred | 0.13 | 0.21 | 0.26 |
| Exit | 0.09 | 0.21 | 0.31 |
| TFA | | | |
| Same school | 0.82 | 0.33 | 0.17 |
| Transferred | 0.08 | 0.13 | 0.16 |
| Exit | 0.10 | 0.54 | 0.67 |

**Table 3. Multinomial Logit Estimates of Transfer and Exit Decisions with School Fixed Effects (Odds Ratios)**

| | Transfer | | | Exit | | |
|---|---|---|---|---|---|---|
| | After year 1 | After year 2 | After year 3 | After year 1 | After year 2 | After year 3 |
| NYCTF | 1.492** | 1.764** | 1.735** | 0.827** | 1.973** | 2.224** |
| TFA | 0.656** | 1.677** | 1.541* | 0.710** | 10.614** | 5.658** |
| N | 59086 | 35886 | 23415 | 59576 | 41064 | 27876 |

The results in Table 3 represent the average behavior of all teachers during the 2000-2008 period; however, retention patterns of teachers may have changed over time. We explore differences across time in Table 4, where we categorize teachers by their pathway and their cohort, with all results relative to behaviors of the late cohort of NYCTF teachers. Early cohort

teachers were in their first year of teaching in 2000-2002, mid cohort teachers from 2003-2005 and late cohort teachers from 2006-2008.

The results, supplemented by post-estimation tests of equivalence of coefficients, suggest several trends. First, NYCTF teachers became more likely to transfer after their first or second year over time, while TFA teachers became less likely to transfer after their first year. Second, CR teachers became less likely to exit after their first year, but NYCTF teachers became more likely to exit after their first year. Finally, TFA teachers became more likely to exit over time, particularly after their second year of teaching.

**Table 4. Multinomial Logit Estimates of Transfer and Exit Decisions by Cohort and Pathway with School Fixed Effects (Odds Ratios)**

| | Transfer | | | Exit | | |
|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 |
| Early cohort*CR | 0.473** | 0.391** | 0.555** | 1.294** | 0.486** | 0.450** |
| Mid cohort*CR | 0.745** | 0.603** | 0.616** | 1.122+ | 0.527** | 0.507** |
| Late cohort*CR | 0.585** | 0.465** | 0.543** | 1.029 | 0.455** | 0.438** |
| Early cohort*NYCTF | 0.633** | 0.644** | 0.881 | 0.554** | 0.879 | 0.786 |
| Mid cohort*NYCTF | 0.882* | 0.838* | 1.038 | 0.978 | 0.979 | 1.126 |
| Early cohort*TFA | 0.504** | 0.474* | 0.744 | 0.583* | 3.149** | 1.803* |
| Mid cohort*TFA | 0.471** | 1.165 | 1.056 | 0.716* | 5.023** | 3.052** |
| Late cohort*TFA | 0.323** | 0.691+ | 0.751 | 0.894 | 6.280** | 2.918** |
| N | 59086 | 35886 | 23415 | 59576 | 41064 | 27876 |

***To what extent does the leaving behavior of more or less effective teachers differ across pathways?***

We are particularly interested in the differential career patterns of more and less effective teachers and how this differs across pathway. The current research literature and experts in the field have not settled on a single best method for creating teacher value-added measures. As such we plan to use multiple approaches and compare the robustness of our results across measures. In this analysis we employ a commonly used specification as described by equation (2).

$$A_{ijst} = \beta_0 + \beta_1 A_{ijs(t-1)} + X_{it}\beta_2 + C_{ijst}\beta_3 + S_{st}\beta_4 + T_{jst}\beta_5 + \tau_j + \varepsilon_{ijst} \qquad (2)$$

Like the value-added specification described above, we model a student's achievement as a function of prior achievement, individual student attributes, the characteristics of the students in that classroom, observed attributes of the school (S), teacher experience (T), and a teacher fixed effect, $\tau_j$. The teacher fixed effect, captures our best estimate of a teacher's effectiveness, holding constant the other variables in the model. This specification has the virtue of allowing us to compare teacher effectiveness across schools and thus explore the comparative effectiveness of teacher retention by pathway across teachers in different school environments. The drawback is that there may be unobserved attributes of schools or students which influence retention decisions and which are correlated with teacher pathways, and thus may bias our results. We will explore this in detail for our final report.

Since value-added measures are only available for certain grades and subjects, for these analyses we limit our focus to ELA and math teachers in grades 4-8. Also, due to current data availability, our analyses using ELA value-added only include teachers whose first year of teaching was between 2001-2002 and 2007-2008, a population of 6,406 teachers. Our analyses based on math value-added cover first year teachers between 2000-2001 and 2007-2008, a population of 7,418 teachers. Finally, for these analyses we are only able to examine teachers' decisions after their first and second years of teaching due to small samples in the third year. .

Table 5 presents the mean value-added of teachers as a function of their retention decisions. The measures are standardized with mean 0 and standard deviation 1, so a value above zero is above average while a value below zero is below average. Notably, regardless of the year or subject, the mean value-added for teachers who transferred or exited was lower than that for teachers who remained in the same school.

**Table 5. Mean Value-added by Retention Status and Years of Experience**

| | After year 1 | | After year 2 | |
|---|---|---|---|---|
| | N | mean | N | mean |
| *ELA* | | | | |
| Same school | 5302 | 0.03 | 3691 | 0.08 |
| Transferred | 599 | -0.17 | 334 | -0.17 |
| Exit | 505 | -0.15 | 623 | -0.03 |
| *Math* | | | | |
| Same school | 6094 | 0.05 | 4410 | 0.07 |
| Transferred | 663 | -0.24 | 385 | -0.17 |
| Exit | 661 | -0.24 | 672 | 0.02 |

Tables 6 and 7 present multinomial logit analyses for ELA and math respectively, with controls for teachers' pathways, value-added, and the interaction between pathway and value-added. Tables 6a and 7a are based on models that control for a continuous measure of value-added; Tables 6b and 76b contain the results of models that control for quartiles of value-added. In all models, the main effect of pathways is very consistent with the results from Table 3, despite employing a small subset of Table 3 observations and the inclusion of other controls.

There is little strong evidence of differences in retention behavior based on the pathway and value-added of the teacher. As indicated in Tables 6a, on average all teachers with higher ELA value-added are less likely to transfer following their first year (0.821) and although the point estimates suggest a reduced likelihood of transferring after year 2 and of exiting following years 1 and 2, these results are not statistically significant. None of the results for NYCTF or TFA teachers are significant, but they begin to paint an interesting picture. Higher ELA value-added NYCTF teachers appear somewhat more likely to transfer but less likely to exit than those with lower value-added.

The results based on quartiles tell a similar story (quartile 1 is the lowest, 4 the highest). Higher ELA value-added traditional prep teachers are less likely to transfer (not significant) and less likely to exit after year 1 (significant). However, although not statistically significant, higher ELA value-added NYCTF teachers appear more likely to transfer and less likely to exit. In the end, we find some suggestive but very few reliable relationships for ELA value-added.

**Table 6a. Determinants of Retention Status by Years of Experience, Continuous ELA VA**

| | Transfer | | Exit | |
|---|---|---|---|---|
| | After year 1 | After year 2 | After year 1 | After year 2 |
| NYCTF | 1.362* | 1.734** | 0.921 | 2.252** |
| TFA | 0.918 | 2.640** | 0.698 | 12.609** |
| ELA VA | 0.821* | 0.876 | 0.909 | 0.921 |
| ELA VA*NYCTF | 1.155 | 1.066 | 0.807 | 0.906 |
| ELA VA*TFA | 1.095 | 1.394 | 1.115 | 1.329 |
| N | 2977 | 1378 | 3011 | 2300 |

**Table 6b. Determinants of Retention Status by Years of Experience, Quartiles of ELA VA**

| | Transfer | | Exit | |
|---|---|---|---|---|
| | After year 1 | After year 2 | After year 1 | After year 2 |
| NYCTF | 1.232 | 1.499 | 1.068 | 2.910** |
| TFA | 0.822 | 1.441 | 0.543 | 10.450** |
| ELA-q2 | 0.715 | 0.645 | 0.503** | 1.060 |
| ELA-q3 | 0.832 | 0.723 | 0.600* | 0.860 |
| ELA-q4 | 0.707 | 0.607 | 0.704 | 0.952 |
| ELA-q2*NYCTF | 1.114 | 1.311 | 0.762 | 0.784 |
| ELA-q3*NYCTF | 0.972 | 0.959 | 1.147 | 0.539 |
| ELA-q4*NYCTF | 1.470 | 1.669 | 0.747 | 0.868 |
| ELA-q2*TFA | 1.556 | 2.265 | 2.110 | 0.772 |
| ELA-q3*TFA | 0.911 | 3.515 | 1.431 | 1.789 |
| ELA-q4*TFA | 0.989 | 1.622 | 0.664 | 1.375 |
| N | 2977 | 1378 | 3011 | 2300 |

The results for math are clearer. As depicted in Table 7a, higher math value-added NYCTF teachers are less likely to exit following their first year than their lower value-added peers. Similar relationships hold for traditional preparation and TFA teachers. For instance, a high value-added NYCTF teacher (1 standard deviation above average) was 47 percent[4] less likely to exit after his/her first year than an average value-added NYCTF teacher. Compared to an average value-added traditional preparation teacher, a high value-added CR teacher was 21 percent less likely to exit after his/her first year. Higher value-added teachers are less likely to transfer following the first year across all pathways. It also appears that higher math value-added NYCTF teachers are more likely to transfer following year 2; this result is not statistically significant. The quartile analyses tell a similar story and indicate that the relationship between value-added and retention was more pronounced for NYCTF teachers although the TFA results were not significant.

[4] 0.47=1-.787*.676

**Table 7a. Determinants of Retention Status by Years of Experience, Continuous Math VA**

| | Transfer | | Exit | |
|---|---|---|---|---|
| | After year 1 | After year 2 | After year 1 | After year 2 |
| NYCTF | 1.311+ | 1.606** | 0.596** | 2.110** |
| TFA | 0.818 | 1.623 | 0.457** | 12.647** |
| math VA | 0.803** | 0.880 | 0.787** | 0.905 |
| math VA*NYCTF | 0.912 | 1.114 | 0.676** | 1.044 |
| math VA*TFA | 0.966 | 0.732 | 0.603+ | 1.044 |
| N | 3359 | 1826 | 3848 | 2871 |

**Table 7b. Determinants of Retention Status by Years of Experience, Quartiles of Math VA**

| | Transfer | | Exit | |
|---|---|---|---|---|
| | After year 1 | After year 2 | After year 1 | After year 2 |
| NYCTF | 1.221 | 1.134 | 0.922 | 1.876* |
| TFA | 0.519 | 2.226 | 0.632 | 9.457** |
| math-q2 | 0.768 | 0.699 | 0.887 | 0.575* |
| math-q3 | 0.719 | 0.648 | 0.640* | 0.781 |
| math-q4 | 0.514** | 0.770 | 0.618* | 0.582* |
| math-q2*NYCTF | 1.415 | 1.557 | 0.771 | 1.365 |
| math-q3*NYCTF | 0.961 | 1.804 | 0.397* | 0.826 |
| math-q4*NYCTF | 0.990 | 1.483 | 0.477+ | 1.414 |
| math-q2*TFA | 3.016+ | 0.495 | 1.096 | 1.630 |
| math-q3*TFA | 0.783 | 1.499 | 0.709 | 1.208 |
| math-q4*TFA | 2.205 | 0.437 | 0.376 | 1.590 |
| N | 3359 | 1826 | 3848 | 2871 |

## NEXT STEPS

We have made progress exploring the long run effects of alternative certification in NYC. This analysis has addressed some questions but we have more yet to do. The following list identifies the ways we plan to extend the analysis between this report and our final report, a draft of which we plan to submit in late March 2011.

- We have the data in hand and are preparing them to extend each of the analyses presented in this report through the 2009-10 school year.
- We will employ the extended database to (re)estimate a fuller range of teacher fixed effect VA estimates to employ in the analysis exploring retention by teacher

effectiveness. In particular, we will explore models that include alternative ways for controlling for student and school influences. We will also estimate the standard errors of the teacher effects so that we employ Empirical Bayes shrinkage to correct for measurement error in these estimates.

- Because there may well be difference in the attributes of classrooms in schools, we plan to estimate retention models that control for classroom level student attributes. As we add data we plan to extend our retention analyses to include retention for up to 5 years.

- We will address the fourth question in our research proposal, *How have teachers from different pathways affected the overall functioning of NYC public schools?*

# Appendix

Table A1. First-Year Teachers from Most Competitive Colleges

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of most comp | % of CR | freq | % of most comp | % of NYCTF | freq | % of most comp | % of TFA | freq | % of most comp | % of Other |
| 2000 | 267 | 28.0% | 8.7% | 4 | 0.4% | 36.4% | 67 | 7.0% | 68.4% | 614 | 64.5% | 10.6% |
| 2001 | 276 | 27.0% | 9.7% | 106 | 10.4% | 28.9% | 74 | 7.2% | 63.8% | 568 | 55.5% | 10.8% |
| 2002 | 249 | 22.8% | 10.9% | 235 | 21.5% | 21.1% | 23 | 2.1% | 21.1% | 585 | 53.6% | 12.6% |
| 2003 | 318 | 23.0% | 11.1% | 597 | 43.1% | 33.0% | 98 | 7.1% | 56.0% | 372 | 26.9% | 14.0% |
| 2004 | 347 | 20.3% | 10.6% | 967 | 56.5% | 38.2% | 199 | 11.6% | 61.8% | 197 | 11.5% | 13.7% |
| 2005 | 389 | 28.8% | 11.9% | 599 | 44.3% | 30.5% | 208 | 15.4% | 65.8% | 156 | 11.5% | 13.5% |
| 2006 | 405 | 34.8% | 11.8% | 575 | 49.4% | 28.9% | 79 | 6.8% | 16.2% | 104 | 8.9% | 12.1% |
| 2007 | 125 | 61.0% | 3.5% | 28 | 13.7% | 1.5% | 1 | 0.5% | 0.2% | 51 | 24.9% | 9.3% |
| 2008 | 87 | 58.8% | 2.3% | 23 | 15.5% | 1.3% | 0 | 0.0% | 0.0% | 38 | 25.7% | 7.0% |

Table A2. First-Year Teachers from Competitive Colleges

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of comp | % of CR | freq | % of comp | % of NYCTF | freq | % of comp | % of TFA | freq | % of comp | % of Other |
| 2000 | 540 | 35.7% | 17.6% | 2 | 0.1% | 18.2% | 14 | 0.9% | 14.3% | 956 | 63.2% | 16.6% |
| 2001 | 524 | 35.0% | 18.3% | 55 | 3.7% | 15.0% | 19 | 1.3% | 16.4% | 898 | 60.0% | 17.1% |
| 2002 | 393 | 28.6% | 17.2% | 167 | 12.2% | 15.0% | 5 | 0.4% | 4.6% | 808 | 58.8% | 17.4% |
| 2003 | 555 | 40.0% | 19.5% | 353 | 25.4% | 19.5% | 19 | 1.4% | 10.9% | 462 | 33.3% | 17.3% |
| 2004 | 564 | 42.0% | 17.3% | 464 | 34.6% | 18.3% | 52 | 3.9% | 16.1% | 262 | 19.5% | 18.2% |
| 2005 | 573 | 47.3% | 17.5% | 395 | 32.6% | 20.1% | 41 | 3.4% | 13.0% | 203 | 16.7% | 17.5% |
| 2006 | 563 | 54.7% | 16.4% | 313 | 30.4% | 15.7% | 21 | 2.0% | 4.3% | 132 | 12.8% | 15.4% |
| 2007 | 265 | 66.8% | 7.5% | 26 | 6.5% | 1.4% | 2 | 0.5% | 0.4% | 104 | 26.2% | 18.9% |
| 2008 | 182 | 60.5% | 4.8% | 14 | 4.7% | 0.8% | 1 | 0.3% | 0.2% | 104 | 34.6% | 19.1% |

Table A3. First-Year Teachers from Less Competitive Colleges

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of less comp | % of CR | freq | % of less comp | % of NYCTF | freq | % of less comp | % of TFA | freq | % of less comp | % of Other |
| 2000 | 1296 | 36.8% | 42.3% | 2 | 0.1% | 18.2% | 5 | 0.1% | 5.1% | 2222 | 63.0% | 38.5% |
| 2001 | 1185 | 36.5% | 41.4% | 80 | 2.5% | 21.8% | 10 | 0.3% | 8.6% | 1968 | 60.7% | 37.4% |
| 2002 | 949 | 32.2% | 41.5% | 330 | 11.2% | 29.7% | 21 | 0.7% | 19.3% | 1643 | 55.8% | 35.3% |
| 2003 | 1165 | 47.5% | 40.8% | 355 | 14.5% | 19.6% | 10 | 0.4% | 5.7% | 921 | 37.6% | 34.6% |
| 2004 | 1311 | 56.5% | 40.2% | 556 | 24.0% | 22.0% | 22 | 0.9% | 6.8% | 431 | 18.6% | 29.9% |
| 2005 | 1189 | 59.7% | 36.4% | 454 | 22.8% | 23.1% | 18 | 0.9% | 5.7% | 329 | 16.5% | 28.4% |
| 2006 | 1123 | 64.5% | 32.7% | 340 | 19.5% | 17.1% | 7 | 0.4% | 1.4% | 271 | 15.6% | 31.6% |
| 2007 | 611 | 76.1% | 17.2% | 41 | 5.1% | 2.1% | 0 | 0.0% | 0.0% | 151 | 18.8% | 27.4% |
| 2008 | 439 | 71.5% | 11.7% | 31 | 5.0% | 1.8% | 4 | 0.7% | 0.8% | 140 | 22.8% | 25.7% |

Table A4. First-Year Teachers from Not Competitive Colleges

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of not comp | % of CR | freq | % of not comp | % of NYCTF | freq | % of not comp | % of TFA | freq | % of not comp | % of Other |
| 2000 | 708 | 32.6% | 23.1% | 3 | 0.1% | 27.3% | 3 | 0.1% | 3.1% | 1460 | 67.2% | 25.3% |
| 2001 | 660 | 32.7% | 23.1% | 44 | 2.2% | 12.0% | 4 | 0.2% | 3.4% | 1310 | 64.9% | 24.9% |
| 2002 | 471 | 29.9% | 20.6% | 127 | 8.1% | 11.4% | 0 | 0.0% | 0.0% | 979 | 62.1% | 21.0% |
| 2003 | 575 | 43.7% | 20.2% | 170 | 12.9% | 9.4% | 4 | 0.3% | 2.3% | 567 | 43.1% | 21.3% |
| 2004 | 629 | 54.4% | 19.3% | 233 | 20.1% | 9.2% | 11 | 1.0% | 3.4% | 284 | 24.5% | 19.7% |
| 2005 | 537 | 52.7% | 16.4% | 205 | 20.1% | 10.4% | 12 | 1.2% | 3.8% | 265 | 26.0% | 22.9% |
| 2006 | 482 | 58.2% | 14.0% | 178 | 21.5% | 8.9% | 4 | 0.5% | 0.8% | 164 | 19.8% | 19.1% |
| 2007 | 282 | 69.1% | 7.9% | 13 | 3.2% | 0.7% | 0 | 0.0% | 0.0% | 113 | 27.7% | 20.5% |
| 2008 | 232 | 70.1% | 6.2% | 10 | 3.0% | 0.6% | 0 | 0.0% | 0.0% | 89 | 26.9% | 16.3% |

Table A5. First-Year Teachers for whom College is Missing

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of missing | % of CR | freq | % of missing | % of NYCTF | freq | % of missing | % of TFA | freq | % of missing | % of Other |
| 2000 | 255 | 32.4% | 8.3% | 0 | 0.0% | 0.0% | 9 | 1.1% | 9.2% | 524 | 66.5% | 9.1% |
| 2001 | 214 | 26.0% | 7.5% | 82 | 10.0% | 22.3% | 9 | 1.1% | 7.8% | 519 | 63.0% | 9.9% |
| 2002 | 222 | 18.9% | 9.7% | 253 | 21.6% | 22.8% | 60 | 5.1% | 55.0% | 637 | 54.4% | 13.7% |
| 2003 | 240 | 25.0% | 8.4% | 334 | 34.8% | 18.5% | 44 | 4.6% | 25.1% | 341 | 35.6% | 12.8% |
| 2004 | 408 | 39.8% | 12.5% | 311 | 30.3% | 12.3% | 38 | 3.7% | 11.8% | 268 | 26.1% | 18.6% |
| 2005 | 581 | 51.2% | 17.8% | 310 | 27.3% | 15.8% | 37 | 3.3% | 11.7% | 206 | 18.2% | 17.8% |
| 2006 | 864 | 43.0% | 25.1% | 583 | 29.0% | 29.3% | 377 | 18.7% | 77.3% | 187 | 9.3% | 21.8% |
| 2007 | 2273 | 48.3% | 63.9% | 1805 | 38.4% | 94.4% | 495 | 10.5% | 99.4% | 132 | 2.8% | 24.0% |
| 2008 | 2825 | 54.8% | 75.0% | 1679 | 32.6% | 95.6% | 479 | 9.3% | 99.0% | 174 | 3.4% | 31.9% |

Table A6. Average Test Score of First-Year Teachers

| Year | Test | College Recommended | NYCTF | TFA | All Other Paths* |
|---|---|---|---|---|---|
| 2000 | SAT Verbal | 482 | n/a | 608 | 470 |
| | SAT Math | 470 | n/a | 572 | 459 |
| | LAST | 250 | n/a | 276 | 233 |
| 2001 | SAT Verbal | 490 | 574 | 594 | 475 |
| | SAT Math | 477 | 546 | 586 | 464 |
| | LAST | 247 | 268 | 273 | 232 |
| 2002 | SAT Verbal | 484 | 535 | 629 | 484 |
| | SAT Math | 475 | 506 | 615 | 476 |
| | LAST | 244 | 255 | 271 | 235 |
| 2003 | SAT Verbal | 492 | 562 | 608 | 494 |
| | SAT Math | 480 | 534 | 609 | 493 |
| | LAST | 245 | 262 | 271 | 239 |
| 2004 | SAT Verbal | 496 | 565 | 650 | 500 |
| | SAT Math | 491 | 547 | 622 | 494 |
| | LAST | 245 | 267 | 276 | 246 |
| 2005 | SAT Verbal | 499 | 552 | 625 | 502 |
| | SAT Math | 493 | 541 | 640 | 501 |
| | LAST | 247 | 271 | 279 | 245 |
| 2006 | SAT Verbal | 497 | 574 | 660 | 499 |
| | SAT Math | 494 | 558 | 638 | 495 |
| | LAST | 250 | 275 | 282 | 248 |
| 2007 | SAT Verbal | 496 | 557 | 644 | 487 |
| | SAT Math | 495 | 546 | 630 | 484 |
| | LAST | 252 | 271 | 280 | 247 |
| 2008 | SAT Verbal | 493 | 557 | 637 | 494 |
| | SAT Math | 493 | 547 | 652 | 485 |
| | LAST | 252 | 273 | 282 | 248 |

Table A7. Childhood-Certified First-Year Teachers

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of child cert | % of CR | freq | % of child cert | % of NYCTF | freq | % of child cert | % of TFA | freq | % of child cert | % of Other |
| 2000 | 2035 | 76.9% | 66.4% | 0 | 0.0% | 0.0% | 28 | 1.1% | 28.6% | 585 | 22.1% | 6.5% |
| 2001 | 1857 | 68.1% | 65.0% | 271 | 9.9% | 73.8% | 17 | 0.6% | 14.7% | 582 | 21.3% | 6.8% |
| 2002 | 1397 | 52.9% | 61.2% | 768 | 29.1% | 69.1% | 61 | 2.3% | 56.0% | 417 | 15.8% | 5.1% |
| 2003 | 1706 | 48.2% | 59.8% | 1063 | 30.0% | 58.8% | 102 | 2.9% | 58.3% | 667 | 18.9% | 8.9% |
| 2004 | 1913 | 51.1% | 58.7% | 867 | 23.1% | 34.3% | 175 | 4.7% | 54.3% | 792 | 21.1% | 10.5% |
| 2005 | 1782 | 58.5% | 54.5% | 455 | 14.9% | 23.2% | 173 | 5.7% | 54.7% | 638 | 20.9% | 9.5% |
| 2006 | 1651 | 62.2% | 48.0% | 241 | 9.1% | 12.1% | 162 | 6.1% | 33.2% | 599 | 22.6% | 8.8% |
| 2007 | 1720 | 66.8% | 48.4% | 258 | 10.0% | 13.5% | 143 | 5.6% | 28.7% | 452 | 17.6% | 6.9% |
| 2008 | 1863 | 73.5% | 49.5% | 191 | 7.5% | 10.9% | 34 | 1.3% | 7.0% | 447 | 17.6% | 6.8% |

Table A8. Math-Certified First-Year Teachers

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of math cert | % of CR | freq | % of math cert | % of NYCTF | freq | % of math cert | % of TFA | freq | % of math cert | % of Other |
| 2000 | 46 | 59.0% | 1.5% | 0 | 0.0% | 0.0% | 7 | 9.0% | 7.1% | 25 | 32.1% | 0.3% |
| 2001 | 33 | 42.3% | 1.2% | 12 | 15.4% | 3.3% | 9 | 11.5% | 7.8% | 24 | 30.8% | 0.3% |
| 2002 | 33 | 31.4% | 1.4% | 43 | 41.0% | 3.9% | 12 | 11.4% | 11.0% | 17 | 16.2% | 0.2% |
| 2003 | 68 | 20.3% | 2.4% | 186 | 55.5% | 10.3% | 19 | 5.7% | 10.9% | 62 | 18.5% | 0.8% |
| 2004 | 91 | 9.6% | 2.8% | 573 | 60.6% | 22.6% | 34 | 3.6% | 10.6% | 248 | 26.2% | 3.3% |
| 2005 | 88 | 11.3% | 2.7% | 467 | 60.1% | 23.8% | 35 | 4.5% | 11.1% | 187 | 24.1% | 2.8% |
| 2006 | 141 | 14.8% | 4.1% | 605 | 63.5% | 30.4% | 67 | 7.0% | 13.7% | 140 | 14.7% | 2.1% |
| 2007 | 180 | 24.2% | 5.1% | 403 | 54.2% | 21.1% | 71 | 9.6% | 14.3% | 89 | 12.0% | 1.4% |
| 2008 | 181 | 29.6% | 4.8% | 336 | 55.0% | 19.1% | 3 | 0.5% | 0.6% | 91 | 14.9% | 1.4% |

Table A9. Science-Certified First-Year Teachers

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of sci cert | % of CR | freq | % of sci cert | % of NYCTF | freq | % of sci cert | % of TFA | freq | % of sci cert | % of Other |
| 2000 | 30 | 53.6% | 1.0% | 0 | 0.0% | 0.0% | 9 | 16.1% | 9.2% | 17 | 30.4% | 0.2% |
| 2001 | 47 | 51.1% | 1.6% | 14 | 15.2% | 3.8% | 7 | 7.6% | 6.0% | 24 | 26.1% | 0.3% |
| 2002 | 27 | 28.7% | 1.2% | 34 | 36.2% | 3.1% | 12 | 12.8% | 11.0% | 21 | 22.3% | 0.3% |
| 2003 | 55 | 25.9% | 1.9% | 76 | 35.8% | 4.2% | 21 | 9.9% | 12.0% | 60 | 28.3% | 0.8% |
| 2004 | 76 | 17.0% | 2.3% | 135 | 30.1% | 5.3% | 46 | 10.3% | 14.3% | 191 | 42.6% | 2.5% |
| 2005 | 74 | 18.5% | 2.3% | 130 | 32.5% | 6.6% | 46 | 11.5% | 14.6% | 150 | 37.5% | 2.2% |
| 2006 | 62 | 17.1% | 1.8% | 137 | 37.7% | 6.9% | 52 | 14.3% | 10.7% | 112 | 30.9% | 1.7% |
| 2007 | 91 | 20.1% | 2.6% | 213 | 47.0% | 11.1% | 64 | 14.1% | 12.9% | 85 | 18.8% | 1.3% |
| 2008 | 81 | 21.7% | 2.2% | 223 | 59.8% | 12.7% | 0 | 0.0% | 0.0% | 69 | 18.5% | 1.1% |

Table A10. ESL-Certified First-Year Teachers

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of ESL cert | % of CR | freq | % of ESL cert | % of NYCTF | freq | % of ESL cert | % of TFA | freq | % of ESL cert | % of Other |
| 2000 | 53 | 67.9% | 1.7% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 25 | 32.1% | 0.3% |
| 2001 | 48 | 71.6% | 1.7% | 3 | 4.5% | 81.7% | 0 | 0.0% | 0.0% | 16 | 23.9% | 0.2% |
| 2002 | 37 | 35.2% | 1.6% | 52 | 49.5% | 4.7% | 0 | 0.0% | 0.0% | 16 | 15.2% | 0.2% |
| 2003 | 47 | 33.8% | 1.6% | 66 | 47.5% | 3.6% | 0 | 0.0% | 0.0% | 26 | 18.7% | 0.3% |
| 2004 | 65 | 30.2% | 2.0% | 66 | 30.7% | 2.6% | 1 | 0.5% | 0.3% | 83 | 38.6% | 1.1% |
| 2005 | 61 | 31.0% | 1.9% | 91 | 46.2% | 4.6% | 2 | 1.0% | 0.6% | 43 | 21.8% | 0.6% |
| 2006 | 73 | 22.5% | 2.1% | 162 | 50.0% | 8.1% | 38 | 11.7% | 7.8% | 51 | 15.7% | 0.8% |
| 2007 | 67 | 22.1% | 1.9% | 150 | 49.5% | 7.8% | 35 | 11.6% | 7.0% | 51 | 16.8% | 0.8% |
| 2008 | 80 | 30.4% | 2.1% | 137 | 52.1% | 7.8% | 2 | 0.8% | 0.4% | 44 | 16.7% | 0.7% |

Table A11. Special Ed-Certified First-Year Teachers

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of spec ed cert | % of CR | freq | % of spec ed cert | % of NYCTF | freq | % of spec ed cert | % of TFA | freq | % of spec ed cert | % of Other |
| 2000 | 398 | 73.3% | 13.0% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 145 | 26.7% | 1.6% |
| 2001 | 364 | 70.7% | 12.7% | 9 | 1.7% | 2.5% | 1 | 0.2% | 0.9% | 141 | 27.4% | 1.6% |
| 2002 | 313 | 60.4% | 13.7% | 75 | 14.5% | 6.7% | 0 | 0.0% | 0.0% | 130 | 25.1% | 1.6% |
| 2003 | 401 | 48.9% | 14.1% | 184 | 22.4% | 10.2% | 2 | 0.2% | 1.1% | 233 | 28.4% | 3.1% |
| 2004 | 537 | 32.6% | 16.5% | 715 | 43.4% | 28.2% | 65 | 3.9% | 20.2% | 329 | 20.0% | 4.4% |
| 2005 | 393 | 29.7% | 12.0% | 685 | 51.8% | 34.9% | 29 | 2.2% | 9.2% | 216 | 16.3% | 3.2% |
| 2006 | 378 | 27.9% | 11.0% | 723 | 53.4% | 36.3% | 63 | 4.7% | 12.9% | 189 | 14.0% | 2.8% |
| 2007 | 465 | 32.7% | 13.1% | 725 | 51.1% | 37.9% | 78 | 5.5% | 15.7% | 152 | 10.7% | 2.3% |
| 2008 | 527 | 38.1% | 14.0% | 676 | 48.9% | 38.5% | 3 | 0.2% | 0.6% | 176 | 12.7% | 2.7% |

Table A12. Other-Certified First-Year Teachers

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of oth cert | % of CR | freq | % of oth cert | % of NYCTF | freq | % of oth cert | % of TFA | freq | % of oth cert | % of Other |
| 2000 | 760 | 63.1% | 24.8% | 0 | 0.0% | 0.0% | 54 | 4.5% | 55.1% | 390 | 32.4% | 4.4% |
| 2001 | 726 | 57.9% | 25.4% | 70 | 5.6% | 19.1% | 83 | 6.6% | 71.6% | 375 | 29.9% | 4.4% |
| 2002 | 579 | 54.1% | 25.4% | 170 | 15.9% | 15.3% | 36 | 3.4% | 33.0% | 286 | 26.7% | 3.5% |
| 2003 | 829 | 48.1% | 29.1% | 345 | 20.0% | 19.1% | 55 | 3.2% | 31.4% | 496 | 28.8% | 6.6% |
| 2004 | 1000 | 40.2% | 30.7% | 472 | 19.0% | 18.6% | 130 | 5.2% | 40.4% | 886 | 35.6% | 11.7% |
| 2005 | 941 | 45.6% | 28.8% | 404 | 19.6% | 20.6% | 125 | 6.1% | 39.6% | 592 | 28.7% | 8.8% |
| 2006 | 1059 | 48.1% | 30.8% | 392 | 17.8% | 19.7% | 154 | 7.0% | 31.6% | 596 | 27.1% | 8.8% |
| 2007 | 1138 | 58.4% | 32.0% | 278 | 14.3% | 14.5% | 151 | 7.7% | 30.3% | 382 | 19.6% | 5.9% |
| 2008 | 1283 | 51.3% | 34.1% | 301 | 12.0% | 17.1% | 479 | 19.2% | 99.0% | 438 | 17.5% | 6.7% |

Table A13. Elementary School Teachers

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of elem | % of CR | freq | % of elem | % of NYCTF | freq | % of elem | % of TFA | freq | % of elem | % of Other |
| 2000 | 2,059 | 41.2% | 67.2% | 8 | 0.2% | 72.7% | 52 | 1.0% | 53.1% | 2,882 | 57.6% | 49.9% |
| 2001 | 1,889 | 41.1% | 66.1% | 253 | 5.5% | 68.9% | 67 | 1.5% | 57.8% | 2,388 | 51.9% | 45.4% |
| 2002 | 1,408 | 35.5% | 61.6% | 758 | 19.1% | 68.2% | 61 | 1.5% | 56.0% | 1,741 | 43.9% | 37.4% |
| 2003 | 1,627 | 46.8% | 57.0% | 992 | 28.6% | 54.8% | 95 | 2.7% | 54.3% | 760 | 21.9% | 28.5% |
| 2004 | 1,706 | 50.8% | 52.3% | 1,030 | 30.7% | 40.7% | 134 | 4.0% | 41.6% | 487 | 14.5% | 33.8% |
| 2005 | 1,849 | 60.3% | 56.6% | 628 | 20.5% | 32.0% | 156 | 5.1% | 49.4% | 433 | 14.1% | 37.4% |
| 2006 | 1,951 | 62.8% | 56.8% | 572 | 18.4% | 28.8% | 226 | 7.3% | 46.3% | 357 | 11.5% | 41.6% |
| 2007 | 2,036 | 64.8% | 57.3% | 633 | 20.1% | 33.1% | 197 | 6.3% | 39.6% | 276 | 8.8% | 50.1% |
| 2008 | 2,155 | 70.0% | 57.2% | 475 | 15.4% | 27.0% | 192 | 6.2% | 39.7% | 256 | 8.3% | 47.0% |

Table A14. Middle School Teachers

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of middle | % of CR | freq | % of middle | % of NYCTF | freq | % of middle | % of TFA | freq | % of middle | % of Other |
| 2000 | 498 | 24.8% | 16.2% | 3 | 0.1% | 27.3% | 42 | 2.1% | 42.9% | 1,469 | 73.0% | 25.4% |
| 2001 | 475 | 22.0% | 16.6% | 63 | 2.9% | 17.2% | 49 | 2.3% | 42.2% | 1,568 | 72.8% | 29.8% |
| 2002 | 415 | 19.3% | 18.2% | 202 | 9.4% | 18.2% | 48 | 2.2% | 44.0% | 1,480 | 69.0% | 31.8% |
| 2003 | 524 | 28.2% | 18.4% | 427 | 23.0% | 23.6% | 80 | 4.3% | 45.7% | 828 | 44.5% | 31.1% |
| 2004 | 696 | 37.2% | 21.4% | 663 | 35.4% | 26.2% | 174 | 9.3% | 54.0% | 338 | 18.1% | 23.4% |
| 2005 | 588 | 40.3% | 18.0% | 483 | 33.1% | 24.6% | 139 | 9.5% | 44.0% | 250 | 17.1% | 21.6% |
| 2006 | 594 | 41.4% | 17.3% | 494 | 34.4% | 24.8% | 191 | 13.3% | 39.1% | 157 | 10.9% | 18.3% |
| 2007 | 567 | 42.2% | 15.9% | 487 | 36.2% | 25.5% | 211 | 15.7% | 42.4% | 80 | 5.9% | 14.5% |
| 2008 | 546 | 43.4% | 14.5% | 447 | 35.5% | 25.4% | 165 | 13.1% | 34.1% | 101 | 8.0% | 18.5% |

Table A15. High School Teachers

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of high | % of CR | freq | % of high | % of NYCTF | freq | % of high | % of TFA | freq | % of high | % of Other |
| 2000 | 291 | 26.6% | 9.5% | 0 | 0.0% | 0.0% | 0 | 0.0% | 0.0% | 801 | 73.4% | 13.9% |
| 2001 | 305 | 27.5% | 10.7% | 32 | 2.9% | 8.7% | 0 | 0.0% | 0.0% | 774 | 69.7% | 14.7% |
| 2002 | 286 | 23.1% | 12.5% | 99 | 8.0% | 8.9% | 0 | 0.0% | 0.0% | 854 | 68.9% | 18.4% |
| 2003 | 445 | 31.9% | 15.6% | 211 | 15.1% | 11.7% | 0 | 0.0% | 0.0% | 740 | 53.0% | 27.8% |
| 2004 | 513 | 37.7% | 15.7% | 485 | 35.6% | 19.2% | 5 | 0.4% | 1.6% | 359 | 26.4% | 24.9% |
| 2005 | 448 | 37.6% | 13.7% | 477 | 40.0% | 24.3% | 6 | 0.5% | 1.9% | 262 | 22.0% | 22.6% |
| 2006 | 495 | 42.3% | 14.4% | 463 | 39.6% | 23.3% | 24 | 2.1% | 4.9% | 187 | 16.0% | 21.8% |
| 2007 | 491 | 46.9% | 13.8% | 437 | 41.7% | 22.8% | 29 | 2.8% | 5.8% | 91 | 8.7% | 16.5% |
| 2008 | 575 | 47.7% | 15.3% | 478 | 39.7% | 27.2% | 58 | 4.8% | 12.0% | 94 | 7.8% | 17.2% |

Table A16. Other School Teachers

| | College Recommended | | | NYCTF | | | TFA | | | All Other Paths | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | freq | % of other | % of CR | freq | % of other | % of NYCTF | freq | % of other | % of TFA | freq | % of other | % of Other |
| 2000 | 218 | 25.8% | 7.1% | 0 | 0.0% | 0.0% | 4 | 0.5% | 4.1% | 624 | 73.8% | 10.8% |
| 2001 | 190 | 25.6% | 6.6% | 19 | 2.6% | 5.2% | 0 | 0.0% | 0.0% | 533 | 71.8% | 10.1% |
| 2002 | 175 | 21.7% | 7.7% | 53 | 6.6% | 4.8% | 0 | 0.0% | 0.0% | 577 | 71.7% | 12.4% |
| 2003 | 257 | 33.3% | 9.0% | 179 | 23.2% | 9.9% | 0 | 0.0% | 0.0% | 335 | 43.5% | 12.6% |
| 2004 | 344 | 35.7% | 10.6% | 353 | 36.6% | 13.9% | 9 | 0.9% | 2.8% | 258 | 26.8% | 17.9% |
| 2005 | 384 | 38.9% | 11.7% | 375 | 38.0% | 19.1% | 15 | 1.5% | 4.7% | 214 | 21.7% | 18.5% |
| 2006 | 397 | 37.4% | 11.6% | 460 | 43.4% | 23.1% | 47 | 4.4% | 9.6% | 157 | 14.8% | 18.3% |
| 2007 | 462 | 47.0% | 13.0% | 356 | 36.2% | 18.6% | 61 | 6.2% | 12.2% | 104 | 10.6% | 18.9% |
| 2008 | 489 | 48.5% | 13.0% | 357 | 35.4% | 20.3% | 69 | 6.8% | 14.3% | 94 | 9.3% | 17.2% |

Table A 17: Mean Attributes of Students of First Year Teachers by Pathway, 2000-2008

| | % Black or Hispanic Students | | | | % Free or Reduced Price Lunch Students | | | |
|---|---|---|---|---|---|---|---|---|
| | CR | NYCTF | TFA | Other Path | CR | NYCTF | TFA | Other Path |
| 2000 | 74.7% | 94.1% | 98.4% | 86.8% | 85.7% | 97.5% | 98.9% | 92.4% |
| 2001 | 71.8% | 97.3% | 97.8% | 82.7% | 84.8% | 97.8% | 97.7% | 89.9% |
| 2002 | 70.1% | 94.2% | 98.0% | 79.1% | 83.6% | 96.0% | 98.3% | 88.3% |
| 2003 | 69.8% | 92.6% | 97.7% | 77.4% | 85.3% | 95.6% | 97.1% | 89.0% |
| 2004 | 69.5% | 88.3% | 95.6% | 71.9% | 86.3% | 94.4% | 96.8% | 87.9% |
| 2005 | 69.9% | 85.1% | 96.0% | 73.2% | 85.8% | 93.3% | 95.6% | 87.9% |
| 2006 | 73.0% | 85.9% | 96.1% | 77.0% | 85.5% | 91.7% | 95.8% | 85.5% |
| 2007 | 73.2% | 86.8% | 95.7% | 76.2% | 86.3% | 92.0% | 94.8% | 88.4% |
| 2008 | 70.8% | 85.6% | 95.4% | 73.0% | 83.3% | 89.3% | 93.7% | 85.4% |

| | Mean Suspensions per 100 Students | | | | Mean Student Absences | | | |
|---|---|---|---|---|---|---|---|---|
| | CR | NYCTF | TFA | Other Path | CR | NYCTF | TFA | Other Path |
| 2000 | 4.2 | 5.5 | 5.8 | 5.5 | 12.6 | 15.1 | 14.9 | 14.4 |
| 2001 | 4.6 | 6.4 | 6.4 | 6.3 | 12.8 | 17.1 | 16.1 | 14.4 |
| 2002 | 2.0 | 1.8 | 2.8 | 2.4 | 12.1 | 14.8 | 15.6 | 13.7 |
| 2003 | 2.0 | 2.2 | 2.7 | 2.9 | 12.1 | 14.8 | 14.9 | 13.7 |
| 2004 | 2.3 | 2.4 | 2.0 | 2.7 | 12.1 | 14.6 | 15.4 | 12.9 |
| 2005 | 2.8 | 4.3 | 3.5 | 4.0 | 12.2 | 14.4 | 15.7 | 12.9 |
| 2006 | 4.3 | 6.7 | 6.2 | 5.3 | 12.9 | 15.1 | 17.8 | 13.6 |
| 2007 | 11.6 | 17.8 | 16.8 | 12.6 | 12.4 | 14.7 | 15.6 | 12.9 |
| 2008 | 8.6 | 14.8 | 13.8 | 9.8 | 11.4 | 13.6 | 14.7 | 11.8 |

| | Average Prior Normalized Math score | | | | | Average Prior Normalized ELA score | | | |
|---|---|---|---|---|---|---|---|---|---|
| | CR | NYCTF | TFA | Other Path | | CR | NYCTF | TFA | Other Path |
| 2000 | -0.04 | -0.40 | -0.37 | -0.22 | | -0.04 | -0.36 | -0.38 | -0.22 |
| 2001 | 0.01 | -0.48 | -0.42 | -0.14 | | 0.00 | -0.43 | -0.43 | -0.15 |
| 2002 | 0.05 | -0.34 | -0.41 | -0.09 | | 0.03 | -0.33 | -0.46 | -0.11 |
| 2003 | 0.01 | -0.30 | -0.44 | -0.10 | | 0.01 | -0.33 | -0.43 | -0.09 |
| 2004 | 0.03 | -0.23 | -0.36 | -0.03 | | 0.03 | -0.25 | -0.39 | -0.03 |
| 2005 | 0.02 | -0.21 | -0.35 | -0.03 | | 0.02 | -0.23 | -0.36 | -0.04 |
| 2006 | 0.00 | -0.19 | -0.38 | -0.05 | | -0.01 | -0.19 | -0.34 | -0.05 |
| 2007 | -0.02 | -0.22 | -0.34 | -0.08 | | -0.01 | -0.21 | -0.31 | -0.09 |
| 2008 | 0.00 | -0.25 | -0.38 | -0.07 | | 0.00 | -0.21 | -0.40 | -0.06 |

**Table A18: The Average Value-Added Effects of Pathways by Experience and School Level, Math and ELA**

The effects estimated in specifications 1 – 3 capture both the differential returns to experience by pathway and also differences in attrition. In an effort to separate these two effects, these basic specifications are estimated again conditional on teachers staying 3 or 5 years.

Math:

| | Full Sample: | | | Conditional on Exp. >3: | | | Conditional on Exp. >5: | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pooled | Elem. | Middle | Pooled | Elem. | Middle | Pooled | Elem. | Middle |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| exp = 2 | 0.0482*** | 0.0654*** | 0.0432*** | 0.0476*** | 0.0629*** | 0.0425*** | 0.0378*** | 0.0644*** | 0.0244** |
| exp = 3 | 0.0791*** | 0.0906*** | 0.0782*** | 0.0742*** | 0.0871*** | 0.0719*** | 0.0508*** | 0.0570*** | 0.0551*** |
| exp = 4 | 0.0918*** | 0.1100*** | 0.0837*** | | | | 0.0670*** | 0.1040*** | 0.0479*** |
| exp = 5 | 0.0925*** | 0.1260*** | 0.0747*** | | | | 0.0679*** | 0.1060*** | 0.0480** |
| exp = 4 plus | | | | 0.0896*** | 0.1190*** | 0.0749*** | | | |
| exp = 6 plus | 0.1020*** | 0.1370*** | 0.0769*** | | | | 0.0802*** | 0.119*** | 0.0513* |
| pathway: TransB | -0.0418* | -0.0412 | -0.0395* | -0.0103 | 0.0087 | -0.0097 | -0.0533* | 0.158*** | -0.0807*** |
| pathway: IE | 0.0003 | 0.0204 | -0.0098 | -0.0035 | 0.0182 | -0.0143 | -0.0180 | -0.0017 | -0.0226 |
| pathway: CR | 0.0049 | 0.0151 | 0.0121 | 0.0035 | 0.0156 | 0.0110 | -0.0143 | -0.0001 | -0.0088 |
| pathway: TFA | 0.0285** | 0.0057 | 0.0532*** | 0.0483*** | 0.0270 | 0.0703*** | -0.0620** | -0.0942* | -0.0417* |
| pathway: unknown | -0.0177* | 0.0001 | -0.0241* | -0.0079 | 0.0115 | -0.0179 | -0.0259* | -0.0152 | -0.0317 |
| pathway: temp license | -0.0083 | -0.0040 | -0.0092 | -0.0066 | 0.0018 | -0.0095 | -0.0242** | -0.0150 | -0.0282** |
| exp 2 * CR | 0.0123 | -0.0007 | 0.0095 | 0.0101 | -0.0019 | 0.0081 | 0.0149 | -0.0080 | 0.0213 |
| exp 3 * CR | -0.0074 | -0.0099 | -0.0159 | -0.0067 | -0.0105 | -0.0159 | 0.0144 | 0.0133 | 0.0079 |
| exp 4 * CR | -0.0097 | -0.0168 | -0.0131 | | | | 0.0086 | -0.0189 | 0.0164 |
| exp 5 * CR | -0.0049 | -0.0288 | 0.0033 | | | | 0.0148 | -0.0144 | 0.0261 |
| exp 4 plus * CR | | | | -0.0132 | -0.0267* | -0.0179 | | | |
| exp 6 plus * CR | -0.0230 | -0.0404* | -0.0194 | | | | -0.0071 | -0.0291 | 0.0011 |
| exp 2 * TFA | 0.0158 | 0.0129 | 0.0057 | -0.0144 | -0.0104 | -0.0261 | 0.0519 | 0.0913 | 0.0236 |
| exp 3 * TFA | 0.0095 | 0.0510 | -0.0251 | -0.0101 | 0.0259 | -0.0406 | 0.0447 | 0.1250* | -0.0116 |
| exp 4 * TFA | 0.0126 | 0.0707* | -0.0529 | | | | 0.0808** | 0.1460** | -0.0037 |
| exp 5 * TFA | -0.0159 | -0.0674 | 0.0855 | | | | 0.0700 | 0.0384 | 0.1530** |
| exp 4 plus * TFA | | | | -0.0311 | -0.0078 | -0.0659* | | | |
| exp 6 plus * TFA | -0.0351 | -0.0027 | -0.0981** | | | | 0.0522 | 0.0957 | -0.0021 |

ELA:

| | Full Sample: | | | Conditional on Exp. >3: | | | Conditional on Exp. >5: | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pooled | Elem. | Middle | Pooled | Elem. | Middle | Pooled | Elem. | Middle |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| exp = 2 | 0.0378*** | 0.0329*** | 0.0397*** | 0.0386*** | 0.0397*** | 0.0381*** | 0.0502*** | 0.0456*** | 0.0520*** |
| exp = 3 | 0.0686*** | 0.0553*** | 0.0752*** | 0.0685*** | 0.0587*** | 0.0739*** | 0.0698*** | 0.0502*** | 0.0877*** |
| exp = 4 | 0.0640*** | 0.0581*** | 0.0690*** | | | | 0.0753*** | 0.0611*** | 0.0898*** |
| exp = 5 | 0.0537*** | 0.0772*** | 0.0381** | | | | 0.0566*** | 0.0773*** | 0.0486*** |
| exp = 4 plus | | | | 0.0599*** | 0.0742*** | 0.0527*** | | | |
| exp = 6 plus | 0.0634*** | 0.0868*** | 0.0382* | | | | 0.0654*** | 0.0882*** | 0.0427* |
| pathway: TransB | 0.0588 | 0.0840 | 0.0543 | 0.0576* | 0.0782 | 0.0583* | 0.1070*** | 0.1680 | 0.0959* |
| pathway: IE | 0.0215** | 0.0167 | 0.0340*** | 0.0250** | 0.0276* | 0.0354** | 0.0321** | 0.0255 | 0.0505*** |
| pathway: CR | 0.0195*** | 0.0160* | 0.0309*** | 0.0214*** | 0.0239** | 0.0309*** | 0.0265*** | 0.0206 | 0.0452*** |
| pathway: TFA | 0.0113 | -0.0007 | 0.0172 | 0.0182 | 0.0155 | 0.0188 | -0.0048 | -0.0300 | 0.0126 |
| pathway: unknown | 0.0075 | 0.0018 | 0.0120 | 0.0154 | 0.0161 | 0.0157 | 0.0182 | 0.0152 | 0.0218 |
| pathway: temp license | 0.0066 | -0.0130 | 0.0232** | 0.0114 | -0.0032 | 0.0255** | 0.0183* | -0.0025 | 0.0373*** |
| exp 2 * CR | -0.0064 | 0.0059 | -0.0189* | -0.0093 | -0.0040 | -0.0197 | -0.0213* | -0.0103 | -0.0351** |
| exp 3 * CR | -0.0269*** | -0.0024 | -0.0455*** | -0.0295*** | -0.0101 | -0.0465*** | -0.0330*** | -0.0019 | -0.0672*** |
| exp 4 * CR | -0.0141 | 0.0096 | -0.0396*** | | | | -0.0305** | -0.0002 | -0.0663*** |
| exp 5 * CR | 0.0017 | 0.0009 | -0.0104 | | | | -0.0061 | -0.0047 | -0.0284 |
| exp 4 plus * CR | | | | -0.0054 | 0.0043 | -0.0279** | | | |
| exp 6 plus * CR | -0.0037 | 0.0019 | -0.0123 | | | | -0.0105 | -0.0046 | -0.0241 |
| exp 2 * TFA | -0.0066 | -0.0023 | -0.0111 | -0.0182 | -0.0232 | -0.0164 | 0.0113 | 0.0238 | -0.0009 |
| exp 3 * TFA | -0.0239 | -0.0126 | -0.0325 | -0.0350* | -0.0299 | -0.0402* | 0.0055 | 0.0270 | -0.0114 |
| exp 4 * TFA | -0.0135 | 0.0791** | -0.0626** | | | | -0.0023 | 0.1060* | -0.0691* |
| exp 5 * TFA | -0.0143 | -0.0457 | 0.0173 | | | | 0.0052 | -0.0032 | 0.0132 |
| exp 4 plus * TFA | | | | -0.0093 | 0.0218 | -0.0326 | | | |
| exp 6 plus * TFA | 0.0153 | 0.0313 | 0.0062 | | | | 0.0364 | 0.0648 | 0.0158 |

**Table A19: The Average Value-Added Effects of Pathways by School Level, Math and ELA**

| | Math | | | | ELA | | | |
|---|---|---|---|---|---|---|---|---|
| | Elem. | Middle | Elem. | Middle | Elem. | Middle | Elem. | Middle |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| pathway: TransB | 0.0429 | 0.0364 | -0.1810 | -0.0782 | 0.233** | -0.0687 | 0.311* | 0.0000 |
| pathway: IE | -0.0237 | -0.0446*** | -0.0026 | -0.0669*** | 0.0339*** | 0.0056 | 0.0801*** | 0.0305* |
| pathway: CR | -0.0115 | -0.0267* | 0.0041 | -0.0631*** | 0.0369*** | 0.0029 | 0.0809*** | 0.0422*** |
| pathway: TFA | 0.0133 | -0.0102 | 0.0260 | -0.0548* | 0.0278 | -0.0066 | 0.0739*** | 0.0047 |
| pathway: unknown | -0.0074 | -0.0343** | 0.0123 | -0.0735*** | 0.0405*** | 0.0038 | 0.0796*** | 0.0321* |
| pathway: temp license | -0.0208 | -0.0414*** | -0.0165 | -0.0885*** | 0.0398*** | -0.0201 | 0.0619*** | 0.0104 |
| continuous cohort | -0.0055 | -0.0070** | | | 0.0051 | -0.0025 | | |
| cont. cohort * TransB | -0.0002 | -0.0099 | | | -0.0523** | 0.0143 | | |
| cont. cohort * CR | 0.0069* | 0.0111*** | | | -0.0081** | 0.0019 | | |
| cont. cohort * IE | 0.0065 | 0.0052 | | | -0.0098** | -0.0025 | | |
| cont. cohort * TFA | 0.0020 | 0.0150** | | | -0.0087* | 0.0028 | | |
| cont. cohort * unknown | 0.0023 | 0.0007 | | | -0.0118*** | 0.0022 | | |
| cont. cohort * temp. license | 0.0008 | 0.0079 | | | -0.0241** | 0.0158* | | |
| continuous year | | | -0.0009 | -0.0110*** | | | 0.0123*** | 0.0073*** |
| year * TransB | | | 0.0324 | 0.0090 | | | -0.0374 | -0.0013 |
| year * IE | | | -0.0012 | 0.0057* | | | -0.0105*** | -0.0038 |
| year * CR | | | 0.0002 | 0.0104*** | | | -0.0095*** | -0.0051** |
| year * TFA | | | -0.0017 | 0.0148*** | | | -0.0099** | -0.0001 |
| year * unknown | | | -0.0024 | 0.0070** | | | -0.0098*** | -0.0031 |