

How Changes in Entry Requirements Alter the Teacher Workforce and Affect Student Achievement

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Introduction

Demographic changes and new policies, such as class-size reduction, are increasing the need for new teachers and, with it, the need for a greater understanding of how to prepare effective teachers. In New York City, for example, retirements and demand for teachers are straining the ability of existing teacher preparation programs to produce sufficient numbers of teachers. In addition, new standards for high achievement by all students require newly entering teachers to be more skilled than in the past. In low-performing schools with high proportions of poor and non-white students, the qualifications of teachers are already substantially worse than in better performing urban and suburban schools (see for example, Lankford, Loeb and Wyckoff, 2002). As the demand for high-quality teachers increases, these disparities are likely to worsen, as schools with better working conditions and higher salaries bid away the better qualified teachers from already difficult-to-staff schools. Many urban districts have begun to rely on new teacher preparation programs that greatly reduce the requirements for course work and experiences in schools prior to becoming a teacher, but provide supports and additional coursework during the first years of teaching. Using data on students and teachers in grades three through eight in New York City, this study assesses the effects of such programs on the teacher workforce and on student achievement. We ask whether teachers who enter through these new routes are more or less effective at improving student achievement than other teachers and whether the presence of these alternative pathways affects the composition of New York City teaching workforce.

Recent research has documented the importance of teachers to student achievement (see, for example, Rivkin, Hanushek, and Kain, 2005; Rockoff, 2004; Sanders and Horn, 1994; and Sanders and Rivers, 1996). Each of these studies documents the improvement of student achievement with increases in teacher experience during the first three to five years of experience, with virtually no additional gains for experience beyond five years. Many other factors, including teachers' verbal ability and subject matter preparation, contribute to teacher effectiveness (Ehrenberg and Brewer 1995; Monk, 1994). Schools may also affect teacher effectiveness through, for examples, resources, administrative leadership, and/or curriculum. There is some evidence that professional education can improve teachers' abilities in the classroom (National Research Council, 2001; Brown and Borko, 1992; Garet et al., 2001; Loucks-Horsley and Matsumoto, 1999; Monk, 1994). This study focuses specifically on pathways into teaching.

At the same time that schools face an increased need for new teachers, researchers and policymakers are engaged in debates over the best way to prepare teachers. While some argue that

easing entry into teaching is the best way to attract strong candidates (U.S. Department of Education, 2002; Finn and Madigan, 2001), others argue that investing in high quality teacher preparation will better serve schools and students (National Commission on Teaching and America's Future, 1996). Most agree, however, that we lack a strong research basis for understanding how best to structure preparation requirements for teaching (see for example, Wilson, Floden, Ferrini-Mundy, 2001). While there are many studies of how aspects of preparation affect teacher beliefs, knowledge, and practices,¹ much of the research is limited in scope, focuses on inputs rather than outcomes, or employs case study methodologies from which it is difficult to determine causal relationships or generalize to other populations. As a result, discussions about effective teacher preparation could benefit from more methodologically sophisticated research to inform the debates, especially as they pertain to preparing teachers for urban settings. (c.f. Cochran-Smith & Zeichner, 2005).

Research on the effects of teacher preparation programs with reduced requirements prior to teaching is scarce, not surprisingly given the relatively recent emergence of these programs. Some evidence, however, suggests that such programs increase the supply of teachers and change the composition of the teacher workforce (see McKibbin (1998) and Shen (1999)). However, to our knowledge, there is no work that assesses the effectiveness of teachers from *large-scale* programs at improving students' academic achievement.

The most relevant studies of student achievement effects come from three studies of Teach for America (TFA), a national program that recruits college seniors to teach in low-income communities for two years. Raymond, Fletcher, and Luque (2001) find that, in Houston, students of TFA teachers had higher test score gains in mathematics than did students of other teachers, many of whom were not certified. Darling-Hammond, Holtzman, Gatlin, and Heilig (2005) use the same data and find mixed effects of TFA teachers on student test score gains, with students of TFA teachers performing relatively better in tests of mathematics than English language arts. Decker, Mayer, and Glazerman (2004) were able to compare teachers within the same grade and school in an experimental format that randomly assigned teachers to students. Using a sample of 17 schools from Baltimore, Chicago, Los Angeles, Houston, New Orleans, and the Mississippi Delta, they find that TFA teachers are more effective at improving student math scores than were other teachers, though there were no statistically significant differences in reading scores.

¹ For relevant work see Ball and Cohen (1999), Carnegie Forum on Education and the Economy (1986), Darling-Hammond (2000), Darling-Hammond and McLaughlin (1999), Feiman-Nemser (1983, 1990), Goodlad (1990), and Holmes Group (1986).

The TFA results may not be reflective of effects of the other programs that have reduced pre-service preparation aimed at increasing the supply of teachers to urban schools. While TFA has brought a substantial number of teachers into schools – approximately 12,000 since 1990 – and the applicant pool has been growing -- between 2000 and 2003 the applicant pool grew from 4,068 to 15,706 and the number of new TFA teachers increased from 868 to 1,656 -- it provides many fewer teachers to urban schools than do the new programs designed specifically to increase the supply of teachers (Decker, Mayer, and Glazerman, 2004). For example, in 2004, the New York City Teaching Fellows program, an alternative route into teaching designed specifically to staff New York City schools, provided almost 2500 new teachers to New York City, while Teach for America provided less than 350. Because they are so large, these new pathways may drastically change the composition of the teacher workforce in city schools. We are not aware of any studies that assess the effectiveness of these large-scale programs.

Pathways into Teaching in New York City

Teachers in New York City can enter teaching through a number of different pathways. In the past, the majority of teachers have come through traditional university-based programs, at both the graduate and undergraduate level. In these programs, students typically fulfill coursework requirements and engage in a variety of field experiences, including student teaching, before being recommended for certification by their colleges or universities. To be recommended for certification through this pathway, teachers must pass the general knowledge exam, the Liberal Arts and Science Test (LAST), a content specialty test (CST), and an assessment of teaching skills. They also must complete a university-based program that is registered with the State of New York.² In what follows, we refer to this pathway as “college recommended.”

Teachers can also be certified through a process of individual evaluation. Such teachers fulfill similar requirements, including student teaching, as those who go through a traditional program, but they can fulfill these requirements at different institutions, and even through distance learning. Once they have completed the requirements for certification, they submit their transcripts to the State Department of Education for review. The state then either issues a certificate or stipulates the requirements that must be met before a certificate can be awarded.

² In 1998 the New York State Board of Regents revised the registration requirements of teacher education programs to be effective for graduates applying for certification beginning in February 2004. These new requirements reflect a substantial increase in preparation requirements. However, very few of the teachers employed in this analysis, all of whom were certified prior to September 2003, would have been affected by these new requirements. In subsequent analysis we will explore the effect of these new requirements.

As the need for teachers to fill the city's classrooms intensified, an increasing number of teachers began to enter teaching without prior preparation. These teachers were hired under temporary licenses, which enabled them to teach as the teacher of record in the classroom, but without having fulfilled certification requirements. In the spring of 2002, New York City employed 12,400 teachers with temporary licenses (New York State Department of Education). The New York State Regents required that all teachers in New York City be certified by September 2003 – in theory ending temporary certification. While the number of teachers holding temporary licenses has declined dramatically, New York State has allowed the limited use of modified temporary licenses to be issued for school districts that are experiencing shortages of certified teachers. However, teachers employed with these modified temporary licenses must have completed at least 27 credit hours of a preparation program and must be actively moving toward certification. In addition, they can not teach in low-performing schools, the licenses are only valid for one year and are currently set to expire following the 2004-05 school year.

Not surprisingly, these new policies resulted in a shortage of certified teachers for New York City. Because of these and similar shortages in other school districts, the Regents approved a framework for alternative routes into teaching, “designed to attract highly competent people who possess a bachelor's degree with a major in the subject they plan to teach, but initially lack courses in teaching,” (Office of Teaching Initiatives, New York State Department of Education). Participants in these alternate route programs are expected to complete 200 hours of pre-service training and pass the LAST and the Content Specialty Test prior to entering the classroom. These teachers are issued “Transitional B” certificates, good for three years, following the introductory component. As teachers of record, they are expected to enroll in teacher education programs at partner colleges to fulfill certification requirements. The New York City Teaching Fellows, Teach for America, and the Teaching Opportunity Program (TOP) are all examples of alternate route programs that provide teachers with Transitional B Certificates. Participants enrolled in alternate route programs must fulfill the same requirements as all other candidates for teaching certificates, and thus by the end of their programs, they have completed a similar set of courses to those taken by graduates of college-recommended programs. However, the costs of entering teaching through an alternative route are substantially less for the individual teacher than the costs of traditional university-based teacher preparation, both because alternative route teachers earn a salary throughout their training and because, for the Teaching Fellows program and Teach for America, they pay a reduced rate for the

coursework taken. Conversely, the cost to the City is higher for these teachers because of the subsidized education.³

Teach for America (TFA) recruits teachers for high-poverty schools in a number of areas around the country. They recruit teachers nationally, targeting recent graduates of elite colleges and universities; the recruitment process is extremely selective. Once corps members are selected, they must attend a summer training institute, run by Teach for America, prior to being placed in a classroom. The curriculum is designed by TFA and includes six components, in addition to a summer teaching experience in New York City. Once corps members begin teaching, they continue to take courses with a local partner university. TFA requires a two-year commitment; at the end of this period, corps members earn certification and many also earn a master's degree.

The NYC Teaching Fellows (Fellows) began in the spring of 2000 to address shortages in NYC public schools. The program targets mid-career professionals as well as recent college graduates in its recruitment. From its inception, the Teaching Fellows program has grown from 325 in its first year to more than 2,000 Fellows in 2004-05. The Fellows program is one of the largest alternate route programs in the country. Currently, over 6,000 Fellows are teaching in NYC schools (www.nyctf.org). Prior to entering the classroom as teachers of record, fellows complete an introductory component, usually offered in the summer, which includes some time in local classrooms. The courses are taught by instructors at the partner universities. Once fellows begin teaching, they continue to take classes at their partner institution. Most Teaching Fellows complete their programs within two years. Teaching Fellows are generally older than TFA corps members, and approximately 20 percent of Fellows have completed graduate degrees. Teaching Fellows are typically placed in shortage subjects and schools and in the last few years are more likely to teach math, science and special education than childhood education.

While TFA and the Teaching Fellows are the focus of this paper, they are not the only alternative routes serving New York City. For example, the Teaching Opportunity Program (TOP) is a collaborative initiative between the City University of New York (CUNY) and the NYC Department of Education to produce middle and high school math, science and Spanish teachers. Participants in TOP also take part in an intensive summer program run by a CUNY campus that includes experiences in local schools. Once they enter the classroom, they continue to take courses

³ The City covers the cost of the summer training program and stipend (about \$2500) for Teaching Fellows. In addition, New York City pays an additional \$8000 toward the cost of their master's degree over the next two years, each of the Teaching Fellows pays \$4000 towards these degrees.

at CUNY that count towards both their certification and MA degrees. TOP participants generally complete their requirements for certification and a MA degree in two to three years, after which they are committed to teaching in NYC public schools for an additional two years.

The distinction between alternative and traditional routes can be quite blurry. For example, many participants in traditional graduate programs in teacher education apply for an internship certificate when they have completed sufficient coursework. With this certificate they are able to become the teacher of record in the classroom, earning a salary while they complete the rest of their program and obtain a master's degree. Given this blurry nature of the distinction between alternative and traditional routes as well as the many pathways into teaching in New York City, there are many ways by which to distinguish pathways. For much of our analyses we divide teachers into six groups as defined by their pathway into their *first* job in New York City. These groups are (1) college recommended; (2) individual evaluation; (3) Teaching Fellows; (4) Teach for America; (5) temporary license; and (6) other. The Other group includes all teachers not fitting in the other five categories, including internship certificates, other Transitional B teachers, and those with certification through reciprocity agreements with other states.

Table 1 shows the trends in the number of first year New York City teachers by pathway. The first trend to notice is the substantial increase in new teachers during the late 1990s and early 2000s. In 1996, 3,406 teachers began working in New York City for the first time. The size of this group peaked in 2003 with 9,176 new teachers entering the school system that year. This increase results from an abnormally small number of new hires in 1996, due to budget restrictions, combined with increasing enrollments, smaller class sizes and increasing attrition over the period. The rise in the number of new teachers corresponded to an increase in the number of college recommended new teachers from 1,260 in 1996 to 2,840 in 1999, but this contributed only a portion of the total number of new teachers. In addition, there was a large increase in the number of teachers with temporary licenses from 1,617 in 1995-1996 to over 4,000 in 2000-2001 and 2001-2002. Prior to the 1999-2000 academic year there were no Teaching Fellows and only a few Teach For America teachers, but these groups grew rapidly over the next four years, providing 2,441 and 350 teachers in 2003-2004, respectively. The rapid increase in the size of these programs corresponds to a substantial decrease in the number of temporary license teachers and a small decrease in the number of college recommended teachers, indicating that the majority of the alternative route teachers are filling positions that previously had been filled by teachers with temporary licenses.

Table 2 describes the characteristics of teachers entering New York City public schools through different pathways. Differences are evident across pathways, with teachers entering through alternative routes demonstrating better performance on measures of academic preparation and/or general ability than those from other pathways. In the 2003-2004 academic year, for example, none of the new TFA teachers and less than two percent of the Teaching Fellows had failed the general knowledge certification exam the first time they took it, compared with 16 percent of college recommended and individual evaluation teachers and 23 percent of temporary license teachers. Similarly 44 percent of Teaching Fellows and 70 percent of TFA members graduated from highly competitive colleges (as rated by Barrons as most competitive or highly competitive), compared with much lower rates from the other pathways.

A relevant question is whether the introduction of the Teaching Fellows and TFA programs altered the characteristics of teachers entering through other routes. Given the economic incentives, it would not be surprising if it had. The trends in Table 2 show some indication of this, but the effects appear small. For example, the scores on the LAST for college recommended teachers drops slightly after the introduction of the Teaching Fellows program in 2000-2001. However, the proportion of college recommended and individual evaluation teachers from more competitive colleges increases over this time while the proportion from the least competitive colleges decreases.

In summary, the introduction of new pathways into teaching that reduced both the tuition and the time costs of pre-service preparation attracted many new teachers. These new teachers primarily replaced temporarily license teachers, a group that had been growing in the years prior to the introduction of the new programs. The alternative route teachers have stronger measures of qualifications than teachers entering through any other route and especially stronger than the temporarily licenses teachers they largely replaced. While the presence of the alternative routes is likely to have drawn some teachers away from traditional preparation because they are less costly for the student to complete, the change has not led to a substantial drop in numbers nor in the average measured educational achievement of new college-recommended teachers. In recent years, Teaching Fellows placements are largely targeted on difficult-to-staff subjects, such as middle and high school math and science and special education; subjects that attract very few traditionally prepared applicants.

Data

Estimating the effect of teachers on student achievement requires good student test-score data. At present there are very few places that have data that would allow an examination of the effects of teacher pathways into teaching on the performance of the students they teach. New York City is one such place and, importantly, it provides an extraordinary range and quantity of teaching and learning environments to examine these relationships. In New York State gives state-wide student exams in mathematics and English language arts in 4th and 8th grade. In addition, the New York City Department of Education tests 3rd, 5th, 6th and 7th graders in these subjects. All the exams are aligned to the New York State learning standards and each set of tests is scaled to reflect item difficulty and are equated across grades and over time.⁴ Tests are given to all registered students with limited accommodations and exclusions. Thus, for nearly all students the tests provide a consistent assessment of learning for a student from one grade to the next.

Recent papers by Ballou (2002) and Kane and Staiger (2001) raise concerns about how achievement tests are being used in accountability systems. Sanders (2003) and Rogosa (2002) argue that some of these concerns are overstated, mischaracterized, or can be addressed through proper design of accountability systems. Because the score is the dependent variable, its measurement error reduces the precision of parameter estimates but does not create bias. Our large sample sizes help compensate for potential increases in the standard errors of the estimates. In addition, our goal is not to accurately measure the value added by individual teachers and schools, but rather the relationship between scores and teacher *pathways*, groups that are substantially larger than individual teachers or small schools. Statistically, this requires far less precision in achievement measures than that required for an accountability system.

To conduct the analysis of the relationship between pathways into teaching and student achievement, we create a student database with student exam scores, lagged scores and characteristics of students and their peers linked to their schools, teachers and characteristics of

⁴ There are some discrepancies and changes in the exams. The mathematics exams in all grades are developed by CTB-McGraw Hill. New York State employs CTB-McGraw Hill for its 4th and 8th grade ELA exams. In 2003 New York City switched from CTB to Harcourt Brace for its 3rd, 5th-7th grade exams. At that time there was an equating study done to accommodate the switch in exams producers. There are some differences in the format and dimensions of the state and city exams and there have been some changes in item pools over time. Finally, the state offers the 4th and 8th grade mathematics exams in the first two weeks of May while the City offers the 3rd, 5th-7th mathematics exams the last week of April or the first week of May. The state offers the 4th and 8th grade ELAs exams in the first week of February while the City offers the 3rd, 5th, 6th and 7th ELA exams in the second week of April. Because of these discrepancies, we have normalized each exam by grade and year and included grade and year dummies.

those teachers, including indicators of the pathway into teaching. The student data, provided by the New York City Department of Education (NYCDOE), consists of a demographic data file and an exam data file for each year from 1998-99 through 2003-04. The demographic files include measures of gender, ethnicity, language spoken at home, free-lunch status, special-education status, number of absences, and number of suspensions for each student who was active in any of grades three through eight that year – approximately 450,000 to 500,000 students each year. They also include fall and spring codes for the student’s school, official class (homeroom), and, for upper-grade students for whom the homeroom teacher often is not the subject-matter teacher, the course and section number for the English language arts and for mathematics classes.

The exam files include, among other things, the year in which an exam was given, the grade level of the exam (e.g., a grade between three and eight), and the student’s scaled score on the exam. For most years, the files contain scores for approximately 65,000 to 80,000 students in each grade. The only significant exception is that the files contain no scores for 7th grade English language arts in 2002 because the New York City Department of Education is not confident that exam scores for that year and grade were measured in a manner that was comparable to the 7th grade English language arts exam in other years.

Using these data, we construct a set of records with a student’s current exam score and his or her lagged exam score. For this purpose, a student was considered to have value added information in cases where we had a score in a given subject (ELA or math) for the current year and a score for the same subject in the immediately preceding year for the immediately preceding grade. We do not include cases in which a student took a test for the same grade two years in a row, or where a student skipped a grade.

While NYCDOE does not maintain an identifier linking students directly to their teachers, in most cases we were able to create our own links using school and course identifiers because the NYCDOE’s data systems track the courses taken by each student and the courses taught by each teacher. Based on advice from NYCDOE staff, we matched students in grades three through five to teachers based on the homeroom identifier, and matched students in grades six through eight based on the section of a course being taught. Unfortunately, some middle schools do not participate in NYCDOE’s middle-school performance assessment system (MSPA) and in those cases the course-section identifier is not linked centrally to teachers. Because of this, our matches are much lower for grades six through eight than for grades three through five. The matches for grade six in particular are lower than for other grades. On average, in grades three through five we have valid teacher

identification for approximately 96 to 98 percent of students with exam scores; for grades seven and eight we have valid matches for about two-thirds of students with exam scores; and for grade six we have valid ids for about half of the students. Overall, we had valid ids for approximately 80 percent of students with exam scores.⁵

To enrich our data on teachers, we match New York City teachers to data from New York State Education Department databases, using a crosswalk file provided by NYCDOE that links their teacher file reference numbers to unique identifiers compatible with both databases. We draw variables for NYC teachers from New York State data files as follows:

- **Teacher Experience:** For teacher experience, we use transaction-level data from the NYCDOE Division of Human Resources to identify when individuals joined the NYCDOE payroll system in a teaching position. When this information is missing or when the value is less than the value in the NYSED personnel master files we use the NYSED data.
- **Teacher Demographics:** We draw gender, ethnicity, and age from a combined analysis of all available data files, to choose most-common values for individuals.
- **Undergraduate:** We identify the institutions from which individual teachers earned their undergraduate degrees from the NYS Teacher Certification Database (TCERT) and combine it with the Barron's ranking of college selectivity to construct variables measuring the selectivity of the college from which each teacher graduated.
- **Test performance:** We draw information regarding the teacher certification exam scores of individual teachers and whether they passed on their first attempts from the NYS Teacher Certification Exam History File (EHF).
- **Pathway:** Initial pathway into teaching comes from an analysis of teacher certification applications plus separate data files for individuals who participated in Teach For America, the Teaching Fellows Program, and the New York City Teaching Opportunity Program.
- **College Recommended:** We obtain indicators for whether an individual had completed a college-recommended teacher preparation program and if so, the level of degree obtained (bachelor's or master's), from NYSED's program completers data files.

Using this data, we construct our indicator of the pathway into teaching as follows. Any individual who is separately identified as participating in Teach For America, Teaching Fellows, or the

⁵ The average attributes of 6th through 8th grade students who are matched to teachers compared to those who are not matched are substantially the same with a few exceptions. Matches in 6th and 7th grade had lower achievement gains than non-matches (.019 vs. .105 and .055 v. .061 respectively). Sixth grade achievement scores for non-matches also exceeded those for matches (.212 vs. .159). In addition, matches were more likely to include Black and Asian students and less likely to include Hispanics than non-matches. For the remaining student variables (7th and 8th grade achievement scores, absences, suspensions, white students, home language, gender, free lunch status) differences were frequently statistically significant due to the very large number of students but did not differ by more than 5 percent. As one way of assessing the importance of these differences, we estimated pathway effects by grade and found only small differences across the 6th through 8th grades. We have no reason to believe that differences in achievement gains are correlated with pathways and thus believe our pathway estimates are unbiased.

Teaching Opportunity Program is coded as entering teaching through that pathway, as appropriate. For other individuals, we examine certification application records to determine the *earliest* pathway for which they had approval from NYSED prior to their first teaching job in the New York State public schools, with those pathways defined as: (1) traditional college-recommended; (2) individual evaluation; (3) temporary license (individuals who failed to complete one or more requirements for a teaching certificate, but were allowed to teach under the temporary license provisions, whereby a school district can request NYSED to allow a specific individual to teach in a specific school for a temporary period); (4) Other certificates, including internship certificates, other Transitional B teachers, and those with certification through reciprocity agreements with other states.

Table 3 describes the students in our sample. There are 1,035,949 student observations for the assessment of mathematics achievement and 926,958 student observations for the assessment of ELA achievement. These observations include information on current and prior test performance as well as information on all other variables used in the models except for free lunch program participation. There is substantial missing data on this variable and we run our analysis both with the reduced sample and with this variable recoded so that those with missing information are assumed not to be eligible.

The percent of Black and Hispanic student observations are about equal at 35 to 37 percent, while just over 11 percent of student observations are Asian. Approximately three quarters of the sample is eligible for free lunch and approximately 40 percent speak a language other than English at home. As noted above, we have better student coverage in the elementary grades: for example, in math, 27 percent of the sample comes from the fourth grade, compared with 14 percent from the sixth grade and 16 percent from the eighth grade. As expected, the largest group of students is taught by college recommended teachers, though a large proportion is taught by temporary license teachers. The ELA sample has a higher percent of college recommended teachers than does the math sample because these teachers are less likely to teach middle school math. They are replaced there largely by temporary license teachers. Finally, Table 3 gives the average gain in test scores over the year. Because of issues with the tests discussed above, we standardized each test score for each grade and year to have a standard deviation of one and a mean of zero. The average gain in these standardized scores is zero but the standard deviation is 0.66 for math and 0.71 for ELA.⁶

Teachers differ by pathway in the characteristics of their students, as shown in Table 4. For this table, we restrict the data to only first-year teachers, so these are teachers who began teaching in

⁶ The standard deviation of the gain is similar across grade levels.

New York City between 1998-99 and 2003-04. It gives teacher characteristics and the characteristics of the students that they teach. In general, Teaching Fellows and TFA teachers work with students are more likely to be nonwhite, poor and low-performing than teachers from other pathways. While, on average, nine percent of students are white, less than one percent of students taught by TFA teachers are white and only three percent of students taught by Fellows are white, compared with 16 percent of the students of college recommended teachers. Similarly, while approximately 82 percent of the students of first year teachers are eligible for free lunch; the corresponding numbers are 76 percent for college recommended, 88 percent for Teaching Fellows, 92 percent for TFA and 83 percent for temporary license teachers. Prior test scores show the same pattern. They are -0.26 on average for first year teachers; -0.14 for college recommended; -0.29 for temporary license; -0.38 for Fellows; and -0.51 for TFA members.⁷

Table 4 also shows differences in the characteristics of teachers by pathway. TFA teachers are the youngest; college recommended teachers, the next youngest; and the other pathways include teachers of similar average ages. Most teachers are female, particularly college recommended teachers. Fellows have the highest percent of male teachers, at 33 percent. Most teachers are white. Temporary license teachers are the most racially diverse with 19 percent Black and 28 percent Hispanic. We find that college recommended teachers are the least likely to have attended a highly competitive college, while TFA members are by far the most likely. The temporary license teachers performed the least well on the general knowledge certification exam, with over 30 percent failing on the first try, while no TFA member in this sample failed.

Methods

How do the achievement gains of students differ by the teaching pathway of their teachers? Specifically, do students of teachers that enter the classroom with reduced coursework preparation and few prior field experiences achieve gains that are higher or lower than they would have if they were taught by traditionally certified or temporary license teachers? Analyses considering whether teachers from one pathway are more effective than those from another pathway need to account for differences both in the students that teachers teach and in the work environments in which they teach. As demonstrated by Table 4, different pathways into teaching lead teachers into schools having different characteristics and different students. Thus, we must account for these differences

⁷ The greater proportion of Hispanic students relative to Black students taught by TFA members is largely due to the placement of TFA teachers in Washington Heights and the South Bronx.

in the matching of teachers to schools and students if we are to accurately assess the effect of pathway. Because TFA members, for example, are assigned to schools that have traditionally been difficult-to-staff, the achievement of their students may be lower than the achievement of other students; yet, we would not want to attribute this difference to a negative causal relationship between TFA and student achievement. Importantly, students may be similar in many measured characteristics such as race/ethnicity or free-lunch participation, but have different achievement trajectories due, for example, to the school they attend. If teachers from different pathways are differentially assigned to schools in which students are likely to learn more (or less), then we need to account for these differences.

While there is much agreement among researchers about the need to account for these assignment and selection issues, there is less agreement about which model specification is the most accurate for this accounting. Because of this, we choose to run a number of different specifications in order to test the robustness of the estimated effects. The base model that we used is summarized by Equation 1.

$$A_{isgty} = \gamma_0 + \gamma_1 A_{is'g(g-1)t'(y-1)} + \gamma_2 S_{iy} + C_{jt} \gamma_3 + E_{jt} \gamma_4 + P_j \gamma_5 + \pi_s + \pi_g + \pi_y + \epsilon_{isgty} \quad (1)$$

Here the standardized achievement level (test score) A of student i in school s in grade g with teacher t in year y is a linear function of the student's test score in the prior year plus the square of this, characteristics of the student S , characteristics of the other students in the same grade with the same teacher in that year C , the teacher's teaching experience E , and the pathway the teacher took into teaching P . Student characteristics include gender, race/ethnicity, poverty status, days absent during the prior year, and suspensions in the prior year. The aggregate (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 20th year and then an additional dummy variable for experience greater than 20. In addition, the model includes fixed effects for years, grades and schools. The standards 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 2000 to 2004 period by including a school

fixed effect. One implication of this approach is that the effectiveness of a teacher pathway is compared only to other pathways in the same school. In this way, we do not attribute to teachers or their pathways any effect that may differ from one school to another but that is not measured by the included school or class characteristics.⁸ This is generally a conservative approach to the identification of the effects of pathway effectiveness. We find in our specification checks that the results are robust to an even more conservative approach of including school by year by grade fixed effects that effectively compare a teacher's pathway to other pathways in the same school, year and grade. Finally, we assume that included student and class variables control for any within school assignment of teacher pathways to classes that may be correlated with student achievement.

This model assumes that the returns to experience are similar across pathways. This may not be the case. Teachers from different pathways enter with very different experiences and strengths. We might imagine that teachers who have had few classroom experiences prior to teaching may gain differentially in their teaching effectiveness over the first few years. This may be especially true for teachers entering through alternative certification pathways. They may gain more because they are learning what many teachers learned prior to starting, either through on-the-job-training or through their on-going education in master's programs, plus the typical things that teachers learn over the first couple of years. Alternatively, they may be so overwhelmed by figuring out how to get the class in order or they may have such little training in areas such as child development or the teaching of specific subject matters that they have less time and less of a framework to help them grow as teachers. In a second model, we add interactions between pathway and teacher experience in order to estimate these differences in returns to experience.

Results

Tables 5a and 5b give the results for the base model for Mathematics achievement and English Language Arts achievement, respectively. The base models aggregate the effects of students

⁸ School fixed effects account for unobservable differences across schools. We can not use the same approach for classrooms because there is only one teacher in each classroom. Because of this, we use controls for classroom characteristics; however, there may still be omitted unobserved characteristics related to teacher pathways. In order to assess the likelihood of omitted variables bias, we examine whether *within schools* teachers entering from different pathways systematically teach students with different observed characteristics. If classrooms differ in observables by pathway, they probably are more likely to differ in unobservables as well. We find there is no statistically significant difference in lagged student absences by pathway and the only difference in lagged achievement scores are between temporary license teachers and most other teachers. Teachers with temporary licenses teach students who enter the class with lower test scores. Thus, while it is possible that our estimates may be affected by omitted variable bias, we believe this is unlikely.

in grades 4 through 8. Two sets of estimates are presented; the total pathway effects that summarize the average results by pathway and a set of results that indicate the differential effects of pathway by the level of teacher experience. First consider the student-level variables. As expected, there is a strong positive relationship between the current score and the lagged score. Black and Hispanic students, along with students receiving free lunch, demonstrate smaller gains over the year, in both Mathematics and ELA, than White students and students from higher income families. The estimate for Black students is particularly large. The standard deviation in test score gain over the year for Mathematics is approximately 0.66 points, indicating that Black students gain approximately 16.5 percent of a standard deviation less than White students over the course of a year, holding all else constant. Female students gain less in Math and more in ELA than do male students. Aggregate student measures also appear to affect test score gains. In particular, classes with a greater proportion of Black or Hispanic students or a lower average starting test score gain substantially less on average than other classrooms.

Other studies have found (c.f. Rivkin, Hanushek and Kain (2005) and Rockoff (2003)) that teacher experience is an important influence on student achievement. Tables 5a and 5b provide estimates of these effects for teachers by their level of experience. The experience estimates for this model include two components—the effect of additional years of teaching on the effectiveness of individual teachers and the differential selection of teachers across years of experience both as a result of quitting and through the change in the teacher labor market over time. For example, if many of the least able teachers left after their first year, then student achievement would increase for second year teachers relative to first year teachers even if the teachers who remained in the second year had not improved. Estimates that hold constant the selection of teachers provide insight on the extent to which average student achievement increases as teachers gain the knowledge that comes with experience. If, however, the question is taken from the student perspective, to what extent are students advantaged by having a second or third year teacher relative to a novice, then it is important to include both the individual and selection effects of experience. Since our interest is in understanding the differences across pathways, which potentially include both differential gains in individual teacher effectiveness as well as differential retention, we focus primarily on the total effect.

Tables 5a and 5b show differences in the student achievement gains associated with teaching experience. For example, for math achievement, second year teachers have average gains that are about 0.05 points (7.6% of a standard deviation) larger than those of first year teachers. Third year

teachers have students that gain approximately .02 points larger than second year teachers (.067 - .050 or about three percent of a standard deviation difference in test score gains). There are few gains to experience after the third year of teaching.

The shaded sections of Tables 5a and 5b provide the estimates of the effects of pathways into teaching. These effects are relative to College Recommended teachers. For the total pathway results for Mathematics, we see that the coefficient on Individual Evaluation is -.012, indicating that students with teachers who entered New York City through this pathway show 1.8 percent of a standard deviation less gain in test scores (the standard deviation of the gain is 0.66) than do students with teachers who were College Recommended. Students of Teach For America members have similar test scores to those of college recommended teachers, while students of Teaching Fellows, temporarily license teachers, and teachers who entered through other pathways show the smallest gains, approximately 3.3 percent of standard deviation lower than College Recommended. The relationships for ELA are somewhat different. Individual evaluation teachers have students with gains about equal to those of College Recommended teachers, while students of Teaching Fellows and TFA show lower gains. Temporary license teachers and other teachers demonstrate effects that are somewhat lower than College Recommended teachers and higher than Teaching Fellows.

The effect of experience by pathway is shown in the Experience by Pathway column and is summarized in Table 6. When we examine the results for pathway by experience, teachers improve with experience over the first few years. However, there appears, in this specification, to be little difference in returns to experience across pathways. While the point estimates suggest that Fellows and TFA teachers gain relative to College Recommended teachers as experience increases, in general these gains are not statistically significant in this specification.⁹

The first six columns Tables 7a and 7b report the results of the specification checks described above.¹⁰ The consistency of the estimates across models is striking. For example, for

⁹ The estimates of the differential return to experience in the third year and beyond for TFA members and beyond the third year for Fellows may not be accurate due to small sample sizes for these groups. Because of this we restrict our discussion of results to groups with at least 25 teachers. We also omit from the summary tables to be discussed below the estimates of differential returns to experience for the teachers with greater than three years of experience, though the variables are included in the models.

¹⁰ In addition to the specification checks in Tables 7a and 7b, we have estimated models that attempt to control for the differential timing of the student exams between grades and across years. For example, the 4th grade math exam is often given at the beginning of February. Thus the 5th grade math exam, often given at the beginning of April includes several months of learning partly attributable to the 4th grade teacher. We have estimated models that allocate each student's 5th grade scores proportionately to the 4th and 5th grade teachers. The resulting estimates are very similar to those presented

Math, the effect of Teaching Fellows relative to college recommended teachers is $-.023$ in the base model and $-.025$ in both the model with only teachers with three or fewer years of experience and the two-stage full model; the magnitude of the coefficient increases to $.031$ in the two-stage model with three or fewer years of experience and decreases to $.014$ in the model with student fixed effects. None of these estimates differ statistically from the estimates in Table 5a. As in the base model, the estimated effects of temporary license teachers are very similar to those of Teaching Fellows and the effects of Teach for America members are very similar to those of college recommended teachers.

The specification tests for English Language Arts also give estimates that are similar to base model estimates. The Teaching Fellows and Teach for America members both appear to perform worse than college recommended teachers. Temporary license teachers fall between college recommended and alternative route teachers. The difference between temporary and college recommended and the difference between temporary and Teaching Fellows teachers are both statistically significant ($p=.001$ and $p=.015$, respectively).

The results in Tables 7a and 7b also allow us to assess the importance of controlling for aggregate student characteristics and including school fixed effects. Excluding either school fixed effects or student aggregates, but not both, gives results similar to the full model. However, the estimates are quite different when both aggregate student characteristics and school fixed effects are omitted, even after controlling for detailed student-level characteristics. In particular, both Teaching Fellows and TFA members appear to do much worse when these are omitted. This result is not surprising. These teachers often teach in the most difficult schools. Students in these schools are likely to perform more poorly than other students, even accounting for their prior scores and other individual characteristics. Without these controls, the estimates would attribute school characteristics that differentially disadvantage students in the schools that Fellows and TFA members teach to the skills of these teachers.

In addition to the base model and specification checks presented in Tables 7a and 7b, we estimated several other models. First, the prior models have assumed that pathways do not change in their characteristics over time, but this is not the case. Both Teaching Fellows and Teach For America, for example, continue to change both their selection criteria and their pre-service training. Is there evidence that these programmatic changes affect student performance? To examine this we estimated models by cohort. Unfortunately, the smaller sample sizes result in large standard errors

in the paper. Positive and negative effects are slightly larger and in some cases the precision of the estimates improves slightly.

when the sample is divided in this way. The strongest trend is an improvement in the math performance of Fellows over time. Second, teachers and students are mobile among classrooms, even within a school year. While we cannot fully account for this mobility in our estimates we can estimate models that address this issue. When we limit our sample to teachers who taught in the same school from October through the date of the student achievement exam, we lose some observations but the results are unaffected. Unfortunately, we do not have equivalent information for students. We can eliminate students who were not in the same school in the previous year. This removes all students who switch schools between the two academic years, including those who transitioned to middle school. The sample size for this analysis drops substantially and we can not identify the effects of Teaching Fellows or TFA in the middle school, however, the results for 4th and 5th graders are very consistent with previous estimates. Third, some teachers may be more effective than others teaching students with certain characteristics. We explored this hypothesis for teacher pathways by estimating models that include interactions between pathway and classroom characteristics. However, except for evidence that college recommended teachers do not do as well with classes that have students with a large range of prior test scores, there are few interactions worth noting.¹¹

We find that the effects of pathways differ by grade and thus estimate models that group students into two groups, a fourth and fifth grade group and a one composed of sixth, seventh and eighth graders. The models are specified the same as the Pathway by Experience models in tables 5a and 5b. Table 8 summarizes the pathway by experience estimates. For elementary math, Teaching Fellows start out performing worse, but gain more over the first year than do other teachers. By their second year, their students are doing as well as students of College Recommended teachers. Teach For America members also appear to make substantial gains during their first year but this coefficient is never statistically different from a College Recommended teacher. For Elementary ELA results, Teaching Fellows and TFA members have more trouble improving their students' reading achievement initially than do temporary license teachers or College Recommended teachers, and, unlike the situation for math, these teachers do not make differentially large gains in student achievement by their second year. By their third year differences are not statistically significant.

The middle school estimates, especially for math, are quite different. While temporary license teachers continue to see smaller gains than College Recommended teachers, Teaching Fellows do not perform significantly worse than College Recommended, on average, and TFA

¹¹ All of these estimates are available from the authors on request.

members perform better initially. In addition, Teaching Fellows make significantly greater improvements between their second and third year of teaching than do other teachers and appear to outperform both College Recommended and temporary license teachers. Of the specification checks, the one model with school by year by grade fixed effects finds somewhat different results with Fellows having a negative and significant effect and TFA members having no average effect relative to College Recommended teachers. The results for sixth through eighth grade reading show negative point estimates for both Fellows and TFA teachers, but only the results for Fellows are statistically different from zero. However, Fellows show a differential gain to the third year of experience and at that point outperform both College Recommended and temporary license teachers.

Table 8 allows an easy comparison of Teaching Fellows with College Recommended teachers; however, it is also interesting to see how Fellows perform relative to all other teachers in New York City. Because of the lower performance of teachers with temporary licenses or individual evaluation, the comparison of Fellows with all other teachers provides a more positive view of the gains of Fellow's students. On average, there is no significant difference between the gains of Fellow's students and all others in grades 6 through 8, though elementary students do perform worse with first year Fellows than with all other first year teachers. However, in math second year Fellows show a disproportionate gain and perform at least as well as all other second year teachers. There is no evidence of such a gain for second or third year Fellows in ELA.

How important are the pathway effects? There are several ways of gaining perspective on the magnitude of the estimated effects of pathways. The first is statistical significance—do the estimates of alternative pathways and pathway interactions with experience differ from each other enough to be confident that the differences represent more than random fluctuations? The estimates presented in Tables 5 and 7 identify the pathway coefficients that are statistically different from a first-year College Recommended teacher; Table 8 indicates the statistically different effects when comparing a College Recommended teacher to a teachers from other pathways with similar experience.

A second means of gauging importance is to assess whether the estimated effects are big from a policy perspective. One way of assessing this is to examine the pathway effects relative to other effects. For example, a first-year Teaching Fellow is estimated to show gains that are .02 lower in math than a first-year College Recommended teacher (Table 6). This effect is about 40 percent of the average difference in the improvement of students taught by second-year teachers relative to first-year teachers (.02 compared to .05), which several other researchers have identified as

important. Similarly, a Fellow, on average has students who gain .03 points less in ELA than students of College Recommended teachers; this is approximately equivalent to 43 percent of the difference in gains between a student eligible for free or reduced price lunch and one that is not. We estimate that a third-year Fellow teaching 7th grade math improves student performance by .056 more than a third-year College Recommended teacher and .35 more than a Temporary license teacher. Thus, relative to other estimated effects, pathway differences are of moderate importance.

Alternatively, we could examine the relative increase in scale scores implied by the estimated pathway effects. For example, the average scale score of students on the 2002 7th grade math exam is about 670, with a standard deviation of 48. Our model estimates that the difference between a third year Teaching Fellow a third-year College Recommended teacher in 7th grade math is .056 (.091-.035). This translates into 2.7 scale points. At the median student score (671) an increase of 2.7 scale points moves a student in the middle of the test score distribution ahead of about 2.5 percent of the other students. Most would not judge this to be a large effect, although when this difference is accumulated over a few teachers over time, it could have a meaningful impact.

Teacher Improvement with Experience: The estimated coefficient of the interaction of pathway and experience combines several mechanisms. It includes the gains that individual teachers make over time, but it also includes differential attrition. If the best (worst) teachers leave during the first year, the second year estimates will look worse (better). To see whether selection or learning is driving these results, we estimate models that include fixed effects for teachers. With teacher fixed effects, we cannot identify the effects of pathways because an individual's pathway does not change over time. However, we can include pathway by experience interactions. We find no statistically significant difference in the returns to experience across pathways. The few differences in pathway returns to experience shown in Table 8 are likely due to differences in attrition.

In addition to estimating the previous models, we examine whether the effectiveness of pathways differs by the attributes of students and whether successive cohorts of teachers yield different gains in student achievement. We hypothesized that different pathways may be relatively more effective with students with differing characteristics, such as prior academic achievement or race. We estimate models that include interactions between pathway and classroom characteristics and found little evidence of this by pathway. Likewise we hypothesized that as the attributes of pathways change over time, they may have differing effects on student achievement. Both Teaching Fellows and Teach For America, for example, continue to change both their selection criteria and their pre-service training. Is there evidence that these programmatic changes affect student

performance? Unfortunately, the sample sizes get small and the standard errors, large, when the sample is divided in this way. The strongest trend is an improvement in the math performance of Fellows over time.¹²

Differential Turnover and the Overall Effect of Pathways

The analyses do not present a simple story; yet, a few important relationships emerge. First, it is clear from the numbers in Table 1 that the composition and overall supply of teachers changes as a result of changes to certification requirements; in opening up new certified pathways having lower pre-service requirements and subsidized education, uncertified teachers were largely eliminated. Many teachers entering through these new pathways have strong academic training and perform well on tests of general knowledge. However, there is some evidence that teachers that enter New York City elementary schools through these pathways do not teach Mathematics or English Language Arts as well as teachers from the College Recommended path during their first year. Their mathematics teaching does improve differentially between their first and second year, and they are approximately equivalent to College Recommended teachers during their second year. Teachers who enter New York City middle schools through these pathways do better than those who teach in elementary schools. Teach For America members do a better job of teaching mathematics to middle school students than either temporary license or College Recommended teachers during their first year, while Fellows perform as well as these teachers. By their third year of experience Fellows appear to outperform College Recommended and temporary license teachers. The results for English Language Arts in middle school are not as strong. The students of both Fellows and TFA teachers in their first year have lower achievement gains than College Recommended or temporary license teachers. Teaching Fellows show differentially strong improvement in teaching between their second and third years. Fellows with three years of experience perform about as well as College Recommended teachers with three years of experience and exceed the performance of temporary license teachers.

These estimates tell us something about the relative effectiveness of the pathways for first year, second year and third year teachers, but they do not incorporate the differential retention of these teachers and, thus, do not reflect the average quality of teachers that we might expect to get if we filled teaching positions with teachers from certain pathways relative to other pathways. *How*

¹² Estimates for these models can be found in “How changes in entry requirements alter the teacher workforce and affect student achievement” at www.teacherpolicyresearch.org.

would the academic gains of students differ as a result of school officials systematically filling job openings by hiring teachers entering through one pathway versus another? The answer in part depends upon the relative effectiveness of the first-year, second-year and third-year teachers differentiated by pathway discussed above. However, it is also necessary to account for differences in retention rates across pathways. This follows from the meaningful gains in teacher value-added associated with increased experience over the first few year of teaching. If one pathway consistently has higher turnover even if its teachers do well relative to those in other pathways with *the same experience*, the pathway may not be providing the most effective teachers, on average.

Descriptive statistics characterizing the attrition rates for teachers by pathway in elementary, middle and junior-high schools are shown in Table 9. The statistics reflect the experiences of the cohorts of teachers who began teaching in New York City from 1999-2000 to 2003-2004. The table shows that 11.5 percent of College Recommended teachers leave teaching after the first year and that after four years 37 percent have left. The turnover rates are higher for the temporary license group and the other group in the first year and are substantially higher for TFA members in the following years.¹³

Interpreting the meaningful differences in attrition rates shown is complicated by several factors. With the more recent cohorts of entering teachers not having been observed for the full five years, the attrition rates for greater levels of experience only reflect the pattern for the earlier entering cohorts. This is problematic in that a closer look at the underlying data reveals that attrition rates generally are higher in some years than others. A related issue is that teachers entering through alternative pathways disproportionately entered in recent years. As a result, experience effects could mistakenly be attributed to experience, pathways or a combination of the two. Interpretation is also complicated by the fact that the attrition rates of teachers from various pathways may in part reflect differences in the kinds of schools they are assigned. To account for these and other issues, we estimate a conditional Logit model predicting whether or not a teacher leaves teaching in New York City the following year accounting for pathway, experience dummies, the interaction of experience and pathway, year fixed effects and school fixed-effects. Thus, these estimates are based upon within-school differences in teacher attrition rates and hold constant any effects that vary between schools.

The results indicate that the differences in attrition rates across pathways are statistically significant and meaningful in magnitude. For example, 9.6 percent of Teaching Fellows are

¹³ Note that teachers who transfer to positions in public charters and non-teaching positions are counted as leaving.

predicted to leave teaching after the first year, substantially less than the attrition of College Recommended teachers. The difference between the alternative routes and College Recommended teachers is significant but not as great as prior to controlling for school fixed effects. Over time the relative attrition of Teaching Fellows grows so that it is roughly comparable to College Recommended teachers after two years and exceeds them after three and four years. Those entering through TFA also are relatively more likely to return in the second year. The retention of TFA teachers beyond the second year falls off dramatically, both relative to the traditional routes and the Fellows pathway. After four years, fewer than 20 percent of TFA teachers are predicted to remain teaching in New York City public schools.

How does the average value-added of teachers vary across pathways once differences in teacher retention rates are taken into account? We address this question using the following simulation. Suppose that school officials hired an arbitrary number of new teachers (e.g., 1000) from each of the pathways. For subsequent years, the teachers hired from each pathway are allowed to age through the experience distribution, applying the pathway dependent retention rates implied by the Conditional Logit model. Teachers who quit are replaced by new teachers from the same pathway. These new hires in turn age through the system. In this way, it is possible to simulate how the experience distribution of teachers from each pathway would evolve over time and differ across pathways and, in turn, simulate how such differences would affect the average value-added of the teachers from each pathway.¹⁴

Simulation results are shown in Table 10 for the value-added ELA and Math models estimated separately for grades 4 and 5 and 6 through 8. For comparison purposes, the value-added estimates by pathway and experience level are also shown below each of the simulations by grade level. As an example, consider teachers entering via TFA and teaching fourth or fifth grade math. Their average value-added in the first year of the simulation (relative to first-year college-recommended teachers) is estimated to be -0.034, merely reflecting the estimated value-added for a first-year TFA teacher and the fact that all the teachers are in their first year. In the second year of the simulation, 91.2 percent of the teachers would be in their second year with the remainder newly hired, implying an average value added of 0.35, a figure lower than the 0.042 for a second-year TFA math teacher in fourth or fifth grade but higher than the -0.034 estimated for such a teacher in the

¹⁴ Given the small number of TFA members and Fellows with greater than three years of experience, we assume that after three years of experience student achievement gains remain equal and constant across pathways and the retention differences remain constant and reduce at the overall quit rate for years four and higher.

first year. Rolling the simulation forward, it is possible to see how the average value-added for a particular pathway would change over time as well as how the average value-added estimates would differ across pathways after any given number of years. In general, pathways with high teacher attrition will have their overall student achievement gains reduced as inexperienced teachers with lower student achievement gains are substituted for teachers who would have produced stronger gains in student achievement.

Again, the average value-added results do not tell a simple story. It is still the case that the Teaching Fellows and TFA perform well relative to other pathways in middle school math. In elementary math, after a poor first year, they do approximately as well as teachers from all other routes except for College Recommended. For middle school ELA, the Fellows start out worse but out perform other routes in later years. TFA teachers also start worse but roughly catch up in later years. In 4th and 5th grade ELA, the Fellows perform somewhat worse than other routes with the exception of TFA, which performs worse than Fellows.

Conclusions

What might be the story behind these results? One possibility is that the differential effectiveness of teachers from different pathways comes from differences in experiences working with students prior to beginning as the teacher of record. College Recommended teachers can spend hundreds of hours in the classroom before taking control of their own class, while alternative route teachers may spend comparatively little time in classrooms due to the short duration of their pre-service preparation. A second possible cause for the differences in effectiveness may be differences in coursework prior to entry. This coursework may cover topics from child-development and classroom management to how to teach reading and mathematics. In general, Teaching Fellows and TFA teachers have stronger math backgrounds than teachers from other pathways. Some would suggest that teaching middle school math draws on this stronger background more directly, yielding these teachers a relative advantage in these subjects. In addition, Teaching Fellows and Teach for America members, as well as other Transitional B teachers, enroll in coursework during their first two years of teaching. Our teacher fixed effects estimates indicate that the differential effects of experience across pathways is probably due to the differential attrition of weaker teachers across pathways and not improvements in performance of individual teachers. The administrative data employed here is not well suited to understanding the variety of selection and preparation differences that exist across and within paths.

We are in the midst of what amounts to a national experiment in how best to attract, prepare, and retain teachers, particularly for high poverty urban schools. New York City offers a valuable setting in which to study the effects of different pathways into teaching, as a number of pathways co-exist in the same labor market. In many respects, alternate routes are designed as a recruitment strategy. By targeting elite colleges and universities or recruiting career-changers, both TFA and Teaching Fellows succeed in attracting, and selecting, teachers with stronger academic backgrounds, at least as measured by selectivity of undergraduate institution and test scores. In large measure alternate route teachers are replacing teachers who previously had been uncertified, and thus had not necessarily had any prior or concurrent preparation for teaching. Alternate route teachers are typically placed in schools with more students of poverty, schools that generally have the hardest time attracting and retaining teachers. Both the Fellows and TFA are designed specifically to place teachers in under-served or difficult-to-staff schools.

Our analysis of alternate route teachers suggests that in some instances Fellows and TFA members provide higher student achievement gains than the temporary license teachers they replace. For example, Fellows in their third year of teaching in middle schools outperform temporary license teachers in both math and ELA. More typically alternate route teachers are no worse than the temporary license teachers they replace. When compared to College Recommended teachers alternate route teachers often provide smaller gains in student achievement, at least initially, and for ELA it takes longer to catch up. As noted above many of these differences are not large in magnitude, typically about 2 to 5 percent of a standard deviation, and the variation in effectiveness within pathways is far greater than the average differences between pathways.

In the end, this is likely not to be a story about which pathway is best, nor should it. For example, without alternative routes to teaching it is unlikely New York City could meet New York State and federal requirements to have a qualified teacher in every classroom. Based on this analysis we believe that different pathways bring different strengths to teaching. These differences in pathways provide a means to discuss potential improvements in how all pathways prepare teachers. They also suggest that the assignment of teachers to grades and subjects may be influenced by pathway.

The current analysis does not address a number of important policy questions. For example, what attributes of preparation are most important in increasing student achievement. One can imagine that the gross aggregations by pathways mask the potential strong effects of specific preparation attributes. We are in the process of collecting additional data towards this goal, as well

as to shed light on which *characteristics* of pathways and pre-service education (not simply which pathways) affect teachers' ability to enhance student learning. As part of this data collection effort, we surveyed program participants as they completed their teacher education program in the spring of 2004 at 17 institutions that provide many of the new college-recommended teachers to New York City. In addition, we surveyed all Teaching Fellows and Teach for America members who were completing their summer training in the summer of 2004 to prepare them to take jobs in New York City schools. On this survey we asked questions about the participants' family background, education, selection of pathway into teaching, and many facets of their preparation. In addition, we have completed a survey of all 6000 first-year teachers in New York City public schools inquiring about their background, preparation, induction and the environment in which they work. Finally, we are just completing a detailed analysis of the preparation programs at the 17 schools of education and alternative route programs to understand the structure, requirements and content of preparation that teachers receive. This information will be used to identify the attributes of teacher preparation that most influential in the achievement of students and the retention of teachers.

Another interesting question is how the size and composition of the College Recommended pool of teachers would change if they could offer the financial incentive of reduced tuition towards a masters degree as is currently offered by the alternate route programs? Would they be able to attract a stronger pool of applicants and would that result in higher student achievement gains for that path? This is more difficult to assess. Given the demand for new teachers, debates over entrance requirements, recruitment strategies and teacher preparation are likely to continue for some time. However, the quality of such debates will only improve as data from large scale investigations such as this one begin to inform policy decisions about entry into teaching.

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Table 1: Trends in the Numbers of First Time New York City Teachers Entering Through Different Pathways.

Path of Entry for first time teachers in NYC	year									All
	1996	1997	1998	1999	2000	2001	2002	2003	2004	
College Recommended	1,260	2,192	2,901	2,840	2,618	2,375	2,018	2,434	2,192	20,830
Individual Evaluation	433	740	766	736	657	534	517	712	682	5,777
Teaching Fellow	0	0	0	0	0	383	1,121	1,829	2,441	5,774
Teach For America*						118	115	189	360	782
Temp license	1,617	2,561	2,927	3,495	3,886	4,017	4,230	2,671	607	26,011
Other	50	129	172	192	268	543	912	1106	1263	2,896
Prior NYS teaching	46	94	115	102	110	128	154	235	237	1,221
All	3,406	5,716	6,881	7,365	7,539	8,098	9,067	9,176	7,782	65,030

*prior to 2001, Teach For America members are classified as temporary license teachers

Table 2: Trends in the Characteristics of Teachers Entering New York City for the First Time By Pathway

Path of Entry for first time teachers in NYC	year									All
	1996	1997	1998	1999	2000	2001	2002	2003	2004	
Proportion who failed the general knowledge certification exam										
College Recommended	0.136	0.144	0.143	0.132	0.117	0.126	0.134	0.145	0.162	0.137
Individual Evaluation	0.149	0.14	0.172	0.169	0.173	0.15	0.165	0.172	0.161	0.162
Teaching Fellow						0.056	0.106	0.065	0.018	0.055
Teach For America						0.037	0.02	0.011	0	0.009
Temp license	0.369	0.358	0.362	0.332	0.364	0.385	0.389	0.329	0.227	0.357
Score on Liberal Arts and Science Test - Standard Deviation =										
College Recommended	252.08	250.01	249.97	250.06	250.4	248.39	247.54	247.17	246.07	248.86
Individual Evaluation	262.37	254.59	252.37	250.68	249.84	249.03	249.02	246.38	247.23	249.75
Teaching Fellow						266.83	256.34	261.84	267.46	263.23
Teach For America						273.5	271.62	270.67	275.71	273.33
Temp license	233.71	233.56	234.8	236.51	232.59	229.39	229.41	234.4	241.69	232.97
Proportion from Most or Highly Competitive Colleges										
College Recommended	0.107	0.1	0.085	0.081	0.095	0.102	0.107	0.123	0.114	0.1
Individual Evaluation	0.135	0.147	0.139	0.151	0.154	0.098	0.112	0.135	0.151	0.138
Teaching Fellow						0.361	0.279	0.401	0.442	0.391
Teach For America						0.677	0.462	0.778	0.695	0.694
Temp license	0.14	0.144	0.14	0.136	0.125	0.115	0.126	0.142	0.175	0.132
Proportion from Less or Least Competitive Colleges										
College Recommended	0.233	0.25	0.269	0.256	0.259	0.251	0.235	0.213	0.217	0.245
Individual Evaluation	0.199	0.174	0.212	0.241	0.228	0.312	0.268	0.269	0.281	0.241
Teaching Fellow						0.18	0.15	0.114	0.104	0.121
Teach For America						0.04	0	0.024	0.033	0.03
Temp license	0.262	0.251	0.244	0.27	0.27	0.282	0.272	0.247	0.229	0.264

Table 3: Student Characteristics

Variable	Math Sample (N=960970)		ELA Sample (N=861698)	
	Mean	Std. Dev.	Mean	Std. Dev.
Female	0.510		0.511	
Race/Ethnicity				
White	0.148		0.155	
Black	0.366		0.376	
Hispanic	0.372		0.354	
Asian	0.111		0.111	
Other	0.004		0.004	
Free Lunch	0.729		0.720	
English at home	0.584		0.608	
Grade				
4	0.268		0.284	
5	0.257		0.277	
6	0.141		0.155	
7	0.175		0.151	
8	0.159		0.133	
Prior absences	11.754	10.840	11.759	10.852
Prior suspensions	0.020	0.168	0.019	0.162
Standardized Gain	0.000	0.660	0.001	0.715
Pathway of Teacher				
College Rec	0.384		0.448	
IE	0.139		0.143	
Fellows	0.042		0.045	
TFA	0.009		0.010	
Temporary	0.374		0.308	
Other	0.052		0.046	

Table 4: Characteristics of First-Year Teachers and Their Classes by Pathway into Teaching

	All (n=3766)		CR (n=1239)		IE(n=185)		TF (n=769)		TFA (n=134)		Temp (n=1108)		Other (n=331)	
STUDENT CHARACTERISTICS														
Female	0.507	(0.114)	0.505	(0.120)	0.510	(0.128)	0.511	(0.113)	0.505	(0.110)	0.508	(0.104)	0.507	(0.120)
Race/Ethnicity														
White	0.090	(0.178)	0.158	(0.227)	0.111	(0.212)	0.026	(0.075)	0.008	(0.019)	0.068	(0.142)	0.084	(0.171)
Black	0.389	(0.324)	0.338	(0.322)	0.422	(0.347)	0.420	(0.316)	0.290	(0.209)	0.415	(0.329)	0.436	(0.330)
Hispanic	0.440	(0.303)	0.386	(0.286)	0.370	(0.294)	0.504	(0.301)	0.683	(0.208)	0.447	(0.310)	0.410	(0.301)
Asian	0.077	(0.144)	0.114	(0.170)	0.091	(0.154)	0.045	(0.105)	0.015	(0.036)	0.066	(0.136)	0.066	(0.136)
Other	0.004	(0.016)	0.004	(0.017)	0.007	(0.023)	0.005	(0.016)	0.003	(0.011)	0.004	(0.014)	0.004	(0.016)
Free Lunch	0.819	(0.214)	0.759	(0.255)	0.801	(0.215)	0.885	(0.141)	0.924	(0.093)	0.832	(0.194)	0.817	(0.220)
English	0.572	(0.285)	0.577	(0.280)	0.613	(0.297)	0.582	(0.278)	0.431	(0.237)	0.556	(0.297)	0.619	(0.275)
Absents	12.941	(4.284)	11.997	(4.304)	12.608	(4.376)	13.992	(4.196)	13.937	(4.044)	13.091	(3.941)	13.319	(4.794)
Suspensions	0.021	(0.048)	0.016	(0.042)	0.014	(0.031)	0.021	(0.047)	0.022	(0.036)	0.027	(0.054)	0.022	(0.054)
Score Gain	-0.046	(0.256)	-0.022	(0.258)	-0.059	(0.265)	-0.066	(0.262)	-0.041	(0.255)	-0.046	(0.247)	-0.089	(0.253)
Lag Score	-0.268	(0.550)	-0.153	(0.595)	-0.241	(0.547)	-0.388	(0.466)	-0.511	(0.400)	-0.298	(0.526)	-0.233	(0.593)
TEACHER CHARACTERISTICS														
Age	30.024	(7.955)	28.345	(6.978)	32.708	(8.453)	30.901	(8.519)	24.135	(2.361)	31.067	(7.869)	31.650	(9.155)
Female	0.766	(0.423)	0.874	(0.332)	0.827	(0.379)	0.667	(0.472)	0.716	(0.452)	0.709	(0.454)	0.770	(0.421)
Race/Ethnicity														
White	0.577		0.735		0.661		0.604		0.568		0.377		0.556	
Black	0.120		0.099		0.055		0.082		0.112		0.189		0.092	
Hispanic	0.233		0.103		0.219		0.225		0.120		0.382		0.286	
Other	0.070		0.064		0.066		0.089		0.200		0.052		0.066	
Grade														
4.000	0.292		0.410		0.351		0.209		0.179		0.223		0.281	
5.000	0.363		0.425		0.387		0.406		0.396		0.285		0.271	
6.000	0.130		0.080		0.142		0.122		0.255		0.174		0.135	
7.000	0.135		0.050		0.055		0.174		0.124		0.203		0.189	
8.000	0.078		0.033		0.063		0.089		0.046		0.114		0.123	
Barron's (n)	<i>3120</i>		<i>1074</i>		<i>152</i>		<i>620</i>		<i>98</i>		<i>967</i>		<i>209</i>	
Most	0.183		0.076		0.112		0.382		0.745		0.120		0.220	
Least	0.226		0.254		0.296		0.116		0.020		0.271		0.244	
Exam(n)*	<i>3311</i>		<i>1182</i>		<i>166</i>		<i>726</i>		<i>124</i>		<i>911</i>		<i>202</i>	
Failed	0.178		0.157		0.187		0.054		0.000		0.313		0.248	

* Teacher failed the Liberal Arts and Science Certification Exam or the General Knowledge Certification Exam on his/her first attempt.

Table 5a: Base Model Student Achievement for Math with School Fixed Effects

	Student Measures			Teacher Experience		Teacher Pathway		
	Total Pathway	Experience By Path		Total Pathway	Experience By Path	Total Pathway	Experience By Path	
Lag score	0.659*** (0.002)	0.659*** (0.002)	2 years	0.048*** (0.005)	0.050*** (0.008)	IE	-0.012** (0.005)	-0.014 (0.017)
Lag score sqrd	0.001 (0.001)	0.001 (0.001)	3 years	0.067*** (0.005)	0.067*** (0.009)	Fellows	-0.023*** (0.008)	-0.020* (0.011)
Female	-0.009*** (0.001)	-0.009*** (0.001)	4 years	0.073*** (0.006)	0.079*** (0.008)	TFA	0.007 (0.015)	0.009 (0.018)
Other Ethnicity	-0.088*** (0.011)	-0.088*** (0.011)	5 years	0.077*** (0.006)	0.083*** (0.009)	Temporary	-0.021*** (0.004)	-0.011 (0.009)
Asian	0.114*** (0.003)	0.114*** (0.003)	6 years	0.080*** (0.007)	0.085*** (0.009)	Other	-0.021*** (0.008)	-0.023* (0.013)
Hispanic	-0.083*** (0.003)	-0.083*** (0.003)	7 years	0.068*** (0.007)	0.073*** (0.009)	IE*Exp2		-0.014 (0.023)
Black	-0.109*** (0.003)	-0.109*** (0.003)	8 years	0.075*** (0.008)	0.080*** (0.010)	IE*Exp3		-0.005 (0.024)
English home	-0.047*** (0.002)	-0.047*** (0.002)	9 years	0.070*** (0.008)	0.075*** (0.010)	IE*Exp>3		0.002 (0.018)
Free lunch	-0.046*** (0.002)	-0.046*** (0.002)	10 years	0.074*** (0.008)	0.079*** (0.010)	Fellows*Exp2		0.016 (0.016)
Lagged absent	-0.004*** (0.000)	-0.004*** (0.000)	11 years	0.071*** (0.008)	0.076*** (0.010)	Fellows*Exp3		0.02 (0.023)
Lag suspended	-0.052*** (0.004)	-0.052*** (0.004)	12 years	0.065*** (0.009)	0.070*** (0.011)	Fellows*Exp>3		-0.105*** (0.025)
Class Average Measures			13 years	0.062*** (0.009)	0.067*** (0.011)	TFA*Exp2		-0.004 (0.025)
Other Ethnicity	-0.177 (0.115)	-0.18 (0.115)	14 years	0.080*** (0.010)	0.085*** (0.011)	TFA*Exp3		0.028 (0.045)
Hispanic	-0.182*** (0.028)	-0.183*** (0.028)	15 years	0.056*** (0.009)	0.061*** (0.011)	TFA*Exp>3		-0.012 (0.045)
Black	-0.230*** (0.026)	-0.231*** (0.026)	16 years	0.054*** (0.009)	0.059*** (0.011)	Temp*Exp2		-0.011 (0.011)
Asian	-0.061* (0.033)	-0.061* (0.033)	17 years	0.053*** (0.010)	0.058*** (0.012)	Temp*Exp3		-0.005 (0.012)
English home	0.042** (0.019)	0.042** (0.019)	18 years	0.059*** (0.011)	0.064*** (0.013)	Temp*Exp>3		-0.012 (0.010)
Free lunch	-0.057*** (0.013)	-0.057*** (0.013)	19 years	0.040*** (0.012)	0.045*** (0.014)	Other*Exp2		0.02 (0.020)
Lagged absent	-0.010*** (0.001)	-0.010*** (0.001)	20 years	0.049*** (0.012)	0.054*** (0.014)	Other*Exp3		0.021 (0.022)
Lag suspended	-0.078** (0.033)	-0.077** (0.033)	> 20 years	0.055*** (0.007)	0.059*** (0.009)	Other*Exp>3		-0.003 (0.016)
Lag score	0.154*** (0.005)	0.153*** (0.005)		Year			Grade	
Std. dev. score	0.006 (0.008)	0.006 (0.008)	2000	0.018*** (0.004)	0.018*** (0.004)	5	0.006 (0.005)	0.007 (0.005)
			2001	0.008* (0.004)	0.008* (0.004)	6	0.158*** (0.011)	0.158*** (0.011)
Constant	0.321*** (0.029)	0.324*** (0.029)	2002	0.011*** (0.004)	0.012*** (0.004)	7	0.186*** (0.011)	0.185*** (0.011)
Observations	960,970	960,970	2003	0.004 (0.004)	0.004 (0.004)	8	0.198*** (0.011)	0.197*** (0.011)
R-squared	0.64	0.64						

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Results for TFA in the third year should be interpreted with caution due to small sample sizes.

Table 5b: Base Model Student Achievement for ELA with School Fixed Effects

	Student Measures		Teacher Experience			Teacher Pathway		
	Total Pathway	Experience By Path		Total Pathway	Experience By Path	Total Pathway	Experience By Path	
Lag score	0.606*** (0.002)	0.606*** (0.002)	2 years	0.030*** (0.005)	0.033*** (0.008)	IE	-0.005 (0.005)	0.012 (0.014)
Lag score sqrd	-0.004*** (0.001)	-0.004*** (0.001)	3 years	0.042*** (0.005)	0.041*** (0.008)	Fellows	-0.030*** (0.007)	-0.026*** (0.010)
Female	0.058*** (0.002)	0.058*** (0.002)	4 years	0.041*** (0.006)	0.047*** (0.007)	TFA	-0.031*** (0.012)	-0.032** (0.015)
Other Ethnicity	-0.100*** (0.012)	-0.100*** (0.012)	5 years	0.052*** (0.006)	0.058*** (0.008)	Temporary	-0.012*** (0.004)	-0.004 (0.009)
Asian	0.051*** (0.004)	0.051*** (0.004)	6 years	0.056*** (0.007)	0.062*** (0.008)	Other	-0.021*** (0.007)	-0.013 (0.013)
Hispanic	-0.088*** (0.003)	-0.088*** (0.003)	7 years	0.056*** (0.007)	0.063*** (0.008)	IE*Exp2		-0.014 (0.021)
Black	-0.115*** (0.003)	-0.115*** (0.003)	8 years	0.060*** (0.008)	0.067*** (0.009)	IE*Exp3		-0.004 (0.024)
English home	-0.019*** (0.002)	-0.019*** (0.002)	9 years	0.060*** (0.008)	0.066*** (0.010)	IE*Exp>3		-0.02 (0.015)
Free lunch	-0.069*** (0.002)	-0.069*** (0.002)	10 years	0.054*** (0.009)	0.060*** (0.010)	Fellows*Exp2		-0.011 (0.014)
Lagged absent	-0.003*** (0.000)	-0.003*** (0.000)	11 years	0.058*** (0.009)	0.065*** (0.010)	Fellows*Exp3		0.051** (0.025)
Lag suspended	-0.057*** (0.005)	-0.057*** (0.005)	12 years	0.041*** (0.009)	0.048*** (0.010)	Fellows*Exp>3		-0.038* (0.021)
Class Average Measures			13 years	0.060*** (0.009)	0.067*** (0.011)	TFA*Exp2		0.009 (0.022)
Other Ethnicity	-0.280*** (0.102)	-0.280*** (0.102)	14 years	0.051*** (0.009)	0.058*** (0.011)	TFA*Exp3		0.008 (0.042)
Hispanic	-0.182*** (0.026)	-0.182*** (0.026)	15 years	0.059*** (0.009)	0.065*** (0.011)	TFA*Exp>3		0.032 (0.044)
Black	-0.236*** (0.027)	-0.237*** (0.027)	16 years	0.073*** (0.012)	0.079*** (0.013)	Temp*Exp2		-0.004 (0.011)
Asian	0.047 (0.031)	0.047 (0.031)	17 years	0.056*** (0.012)	0.062*** (0.013)	Temp*Exp3		-0.002 (0.012)
English home	0.023 (0.016)	0.023 (0.016)	18 years	0.054*** (0.012)	0.060*** (0.013)	Temp*Exp>3		-0.011 (0.010)
Free lunch	-0.075*** (0.013)	-0.075*** (0.013)	19 years	0.029** (0.013)	0.035** (0.014)	Other*Exp2		0.001 (0.019)
Lagged absent	-0.008*** (0.001)	-0.008*** (0.001)	20 years	0.031** (0.012)	0.037*** (0.013)	Other*Exp3		-0.009 (0.023)
Lag suspended	0.001 (0.031)	0.001 (0.031)	> 20 years	0.046*** (0.007)	0.052*** (0.008)	Other*Exp>3		-0.011 (0.017)
Lag score	0.199*** (0.004)	0.199*** (0.004)						
				Year			Grade	
Std. dev. score	0.020*** (0.007)	0.020*** (0.007)	2000	0.007* (0.004)	0.008* (0.004)	5	0.003 (0.004)	0.003 (0.004)
			2001	-0.004 (0.004)	-0.004 (0.004)	6	0.125*** (0.004)	0.124*** (0.011)
Constant	0.315*** (0.027)	0.310*** (0.028)	2002	0.002 (0.004)	0.003 (0.004)	7	0.146*** (0.010)	0.146*** (0.010)
Observations	861,698	861,698	2003	-0.003 (0.004)	-0.003 (0.004)	8	0.157*** (0.011)	0.156*** (0.011)
R-squared	0.59	0.59						

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Results for TFA in the third year should be interpreted with caution due to small sample sizes.

Table 6: Effects of Pathway and Experience on Student Achievement by Grade

Path	1 Year Experience	2 Years Experience	3 Years Experience
Math Grades 4 through 8			
College Recommended		.048	.067
Individual Evaluation	-.014	.020	.048
NYC Teaching Fellows	-.020*	.044	.067
TFA	.009	.053	.104
Temporary License	-.011	.026	.051
Other	-.023*	.045	.065
ELA Grades 4 through 8			
College Recommended		.030	.042
Individual Evaluation	.012	.028	.050
NYC Teaching Fellows	-.026*	-.007	.067*
TFA	-.032*	.007	.018
Temporary License	-.004	.022	.036
Other	-.013	.018	.020

Based on estimates in Table 5. Results for TFA in the third year should be interpreted with caution due to small sample sizes.

Table 7a: Specifications checks on the Base Model for Math Achievement

	Base Model	<= 3 Years Experience	Stud FE on Gains	Schl/Year/Grade FE	Two Stage	2 Stage Exp<=3	No Class Controls	No Schl FE	No Schl or Class
IE	-0.012** (0.005)	-0.028** (0.011)	-0.009 (0.006)	-0.011** (0.005)	-0.015** (0.006)	-0.032** (0.013)	-0.014** (0.006)	-0.013** (0.006)	-0.018*** (0.007)
Fellows	-0.023*** (0.008)	-0.025*** (0.009)	-0.014 (0.009)	-0.030*** (0.007)	-0.025*** (0.009)	-0.031*** (0.010)	-0.025*** (0.008)	-0.015* (0.008)	-0.048*** (0.009)
TFA	0.007 (0.015)	-0.001 (0.016)	0.015 (0.017)	-0.005 (0.015)	-0.004 (0.016)	-0.011 (0.018)	0.006 (0.017)	0.002 (0.016)	-0.036** (0.018)
Temp	-0.021*** (0.004)	-0.026*** (0.006)	-0.010** (0.004)	-0.017*** (0.004)	-0.023*** (0.005)	-0.034*** (0.007)	-0.034*** (0.005)	-0.022*** (0.004)	-0.049*** (0.005)
Other	-0.021*** (0.008)	-0.025*** (0.010)	-0.018** (0.008)	-0.015** (0.007)	-0.026*** (0.009)	-0.039*** (0.012)	-0.027*** (0.008)	-0.021*** (0.008)	-0.036*** (0.009)
IE	-0.014 (0.017)	-0.025 (0.017)	-0.026 (0.021)	-0.025* (0.015)	-0.029 (0.019)	-0.041** (0.019)	-0.013 (0.017)	-0.025 (0.018)	-0.035* (0.018)
Fellows	-0.020* (0.011)	-0.031*** (0.011)	-0.01 (0.012)	-0.028*** (0.010)	-0.035*** (0.012)	-0.047*** (0.012)	-0.015 (0.011)	-0.015 (0.011)	-0.038*** (0.011)
TFA	0.009 (0.018)	-0.006 (0.019)	0.029 (0.022)	0.000 (0.018)	-0.009 (0.021)	-0.021 (0.022)	0.010 (0.019)	0.004 (0.020)	-0.032 (0.021)
Temp	-0.011 (0.009)	-0.018* (0.009)	-0.003 (0.010)	-0.012 (0.008)	-0.019* (0.010)	-0.030*** (0.011)	-0.008 (0.009)	-0.018* (0.009)	-0.026*** (0.010)
Other	-0.023* (0.013)	-0.036*** (0.013)	-0.02 (0.015)	-0.020* (0.012)	-0.048*** (0.014)	-0.064*** (0.015)	-0.018 (0.014)	-0.028** (0.013)	-0.030** (0.014)
IE*E2	-0.014 (0.023)	-0.009 (0.023)	0.021 (0.027)	-0.019 (0.021)	0.012 (0.025)	0.017 (0.025)	-0.013 (0.023)	-0.01 (0.024)	-0.009 (0.025)
IE*E3	-0.005 (0.024)	0.000 (0.024)	0.046 (0.029)	0.016 (0.022)	0.003 (0.028)	0.009 (0.028)	-0.004 (0.025)	0.01 (0.027)	0.018 (0.028)
TF*E2	0.016 (0.016)	0.015 (0.016)	0.002 (0.019)	0.021 (0.014)	0.037** (0.017)	0.035** (0.017)	0.018 (0.016)	0.016 (0.016)	0.01 (0.017)
TF*E3	0.02 (0.023)	0.014 (0.023)	0.050* (0.027)	-0.007 (0.019)	0.036 (0.024)	0.028 (0.025)	0.032 (0.023)	0.034 (0.024)	0.035 (0.024)
TFA*E2	-0.004 (0.025)	0.000 (0.024)	-0.033 (0.026)	-0.007 (0.026)	0.004 (0.028)	0.007 (0.028)	0.000 (0.027)	-0.012 (0.027)	-0.008 (0.029)
TFA*E3	0.028 (0.045)	0.046 (0.043)	0.032 (0.042)	-0.023 (0.049)	0.039 (0.047)	0.048 (0.048)	0.058 (0.046)	0.039 (0.046)	0.059 (0.048)
Temp*E2	-0.011 (0.011)	-0.013 (0.011)	-0.007 (0.012)	0.003 (0.010)	-0.006 (0.013)	-0.007 (0.013)	-0.016 (0.012)	-0.011 (0.011)	-0.023** (0.012)
Temp*E3	-0.005 (0.012)	-0.01 (0.012)	-0.007 (0.013)	0.002 (0.011)	0.000 (0.014)	-0.003 (0.014)	-0.02 (0.013)	0.002 (0.013)	-0.018 (0.013)
Other*E2	0.02 (0.020)	0.019 (0.020)	0.003 (0.022)	0.004 (0.017)	0.047* (0.025)	0.053** (0.025)	0.028 (0.022)	0.017 (0.021)	0.021 (0.023)
Other*E3	0.021 (0.022)	0.022 (0.022)	0.018 (0.023)	0.036* (0.020)	0.032 (0.023)	0.037 (0.025)	0.018 (0.023)	0.017 (0.022)	0.014 (0.024)
N	960,970	320,503	960,970	960,970	960,970	320,503	960,970	960,970	960,970

Models include all variables in Table 5. Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Results for TFA in the third year should be interpreted with caution due to small sample sizes.

Table 7b: Specifications checks on the Base Model for ELA Achievement

	Gain as Outcome	<= 3 Years Experience	Stud FE on Gains	Schl/Year/ Grade FE	Two Stage	2 Stage Exp<=3	No Class Controls	No School FE	No Schl or Class
IE	-0.005 (0.005)	0.00 (0.010)	0.002 (0.005)	-0.003 (0.004)	-0.003 (0.005)	-0.004 (0.010)	-0.010* (0.006)	-0.010* (0.005)	-0.023*** (0.006)
Fellows	-0.030*** (0.007)	-0.022*** (0.008)	-0.016** (0.007)	-0.031*** (0.006)	-0.032*** (0.007)	-0.028*** (0.009)	-0.036*** (0.008)	-0.01 (0.008)	-0.061*** (0.010)
TFA	-0.031*** (0.012)	-0.030** (0.013)	-0.031** (0.014)	-0.022* (0.012)	-0.033** (0.013)	-0.035** (0.014)	-0.033** (0.014)	-0.021* (0.012)	-0.081*** (0.015)
Temp	-0.012*** (0.004)	-0.011** (0.006)	-0.002 (0.004)	-0.009*** (0.003)	-0.012*** (0.004)	-0.014** (0.006)	-0.025*** (0.004)	-0.006* (0.004)	-0.041*** (0.004)
Other	-0.021*** (0.007)	-0.016* (0.009)	-0.008 (0.008)	-0.021*** (0.006)	-0.023*** (0.008)	-0.025** (0.011)	-0.030*** (0.008)	-0.014* (0.008)	-0.035*** (0.010)
IE	0.012 (0.014)	0.007 (0.014)	0.001 (0.017)	0.000 (0.013)	-0.001 (0.017)	-0.007 (0.017)	0.011 (0.015)	0.001 (0.014)	-0.012 (0.015)
Fellows	-0.026*** (0.010)	-0.027*** (0.010)	-0.013 (0.011)	-0.023*** (0.009)	-0.030*** (0.011)	-0.034*** (0.011)	-0.028*** (0.010)	-0.012 (0.010)	-0.055*** (0.011)
TFA	-0.032** (0.015)	-0.039** (0.016)	-0.037** (0.017)	-0.029** (0.015)	-0.038** (0.017)	-0.045** (0.018)	-0.038** (0.017)	-0.025 (0.016)	-0.084*** (0.021)
Temp	-0.004 (0.009)	-0.013 (0.009)	0.007 (0.010)	0.000 (0.008)	-0.010 (0.010)	-0.019* (0.010)	0.000 (0.010)	-0.004 (0.009)	-0.023** (0.010)
Other	-0.013 (0.013)	-0.015 (0.013)	-0.025 (0.016)	-0.008 (0.011)	-0.021 (0.015)	-0.026* (0.015)	-0.016 (0.015)	-0.014 (0.014)	-0.033** (0.017)
IE*E2	-0.014 (0.021)	-0.013 (0.021)	-0.008 (0.026)	-0.005 (0.019)	0.002 (0.023)	0.001 (0.024)	-0.017 (0.023)	0.000 (0.021)	-0.01 (0.023)
IE*E3	-0.004 (0.024)	-0.007 (0.024)	0.004 (0.025)	-0.006 (0.020)	0.008 (0.026)	0.008 (0.026)	-0.015 (0.026)	0.005 (0.024)	0.002 (0.026)
TF*E2	-0.011 (0.014)	-0.005 (0.014)	-0.013 (0.016)	-0.009 (0.012)	-0.003 (0.015)	0.002 (0.016)	-0.008 (0.015)	-0.009 (0.014)	-0.018 (0.016)
TF*E3	0.051** (0.025)	0.056** (0.023)	0.031 (0.028)	0.009 (0.018)	0.035* (0.021)	0.038* (0.021)	0.058** (0.027)	0.068** (0.028)	0.073** (0.036)
TFA*E2	0.009 (0.022)	0.021 (0.022)	0.000 (0.028)	0.025 (0.022)	0.014 (0.023)	0.026 (0.024)	0.019 (0.026)	0.000 (0.023)	-0.005 (0.028)
TFA*E3	0.008 (0.042)	0.027 (0.040)	0.004 (0.043)	0.016 (0.039)	-0.004 (0.044)	0.020 (0.045)	0.035 (0.053)	0.022 (0.041)	0.031 (0.053)
Temp*E2	-0.004 (0.011)	0.000 (0.011)	-0.009 (0.013)	0.003 (0.010)	0.007 (0.013)	0.01 (0.013)	-0.011 (0.013)	-0.007 (0.012)	-0.015 (0.013)
Temp*E3	-0.002 (0.012)	0.003 (0.012)	-0.008 (0.014)	-0.008 (0.011)	0.000 (0.013)	0.002 (0.013)	-0.018 (0.013)	0.005 (0.012)	-0.013 (0.014)
Other*E2	0.001 (0.019)	0.002 (0.018)	0.034 (0.023)	-0.029* (0.017)	0.003 (0.021)	0.009 (0.021)	0.01 (0.021)	0.003 (0.020)	0.008 (0.023)
Other*E3	-0.009 (0.023)	-0.010 (0.023)	0.020 (0.028)	-0.013 (0.020)	-0.015 (0.025)	-0.014 (0.025)	0.003 (0.025)	-0.010 (0.024)	-0.001 (0.026)
N	861,698	300,156	861,698	861,698	861,698	300,156	861,698	861,698	861,698

Models include all variables in Table 5. Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Results for TFA in the third year should be interpreted with caution due to small sample sizes.

Table 8: Effects of Pathway and Experience on Student Achievement by Grade

Path	1 Year Experience	2 Years Experience	3 Years Experience
Math Grades 4 and 5			
College Recommended	0	0.048	0.08
Individual Evaluation	-0.009	0.045	0.061
NYC Teaching Fellows	-0.040***	0.055	0.053
TFA	-0.034	0.042	0.106
Temporary License	-0.021	0.034	0.052**
Other	-0.049**	0.066	0.059
ELA Grades 4 and 5			
College Recommended	0	0.035	0.054
Individual Evaluation	0.005	0.031	0.074
NYC Teaching Fellows	-0.035***	0.006*	0.039
TFA	-0.055*	-0.015*	-0.025
Temporary License	-0.015	0.041	0.047
Other	-0.007	0.014	0.008*
Math Grades 6, 7 and 8			
College Recommended	0	0.049	0.035
Individual Evaluation	-0.02	-0.017**	0.028
NYC Teaching Fellows	-0.012	0.03	0.091*
TFA	0.046**	0.057	0.113
Temporary License	-0.018	0.016**	0.04
Other	-0.018	0.021	0.056
ELA Grades 6, 7 and 8			
College Recommended	0	0.032	0.025
Individual Evaluation	0.013	0.032	0.017
NYC Teaching Fellows	-0.025*	-0.016**	0.114**
TFA	-0.030*	0.033	0.051
Temporary License	-0.005	0.004	0.017
Other	-0.021	0.017	0.02

Models include all variables in Table 5 and include the sample identified in the table. All significance tests are relative to College Recommended teachers with the same years of experience. * significant at 10%; ** significant at 5%; *** significant at 1%. Results for TFA in the third year should be interpreted with caution due to small sample sizes.

Table 9: Cumulative Teacher Attrition Rates by Pathway for Elementary, Middle and Junior High School Teachers New York City from 2000 to 2004

Experience	College Recommended	Individual Evaluation	Teaching Fellows	Teach For America	Temporary License	Other
	Actual					
1	0.115	0.139	0.105	0.107	0.184	0.264
2	0.212	0.256	0.278	0.477	0.300	0.402
3	0.290	0.322	0.434	0.727	0.413	0.500
4	0.368	0.391	0.544	0.850	0.501	0.573
	Adjusting for Differences Between School Environments					
1	0.143	0.147	0.096	0.088	0.167	0.252
2	0.261	0.276	0.265	0.426	0.327	0.396
3	0.354	0.355	0.433	0.667	0.435	0.510
4	0.446	0.438	0.547	0.813	0.519	0.592

Table 10: Predicted Average Value-Added by Pathway, Grade Groupings and Years

ELA 4&5							MATH 4&5						
Average VA by Pathways and Years Since Implementation simulation							Average VA by Pathways and Years Since Implementation simulation						
year	CR	IE	TF	TFA	TL	Other	year	CR	IE	TF	TFA	TL	Other
1	0.000	0.005	-0.035	-0.055	-0.015	-0.007	1	0.000	-0.009	-0.040	-0.034	-0.021	-0.049
2	0.030	0.027	0.002	-0.019	0.032	0.009	2	0.041	0.037	0.046	0.035	0.025	0.037
3	0.044	0.058	0.023	-0.035	0.035	0.006	3	0.065	0.048	0.037	0.052	0.036	0.038
4	0.054	0.069	0.027	-0.026	0.044	0.013	4	0.071	0.056	0.039	0.046	0.042	0.042
5	0.059	0.076	0.029	-0.027	0.048	0.017	5	0.073	0.058	0.041	0.048	0.043	0.044
VA by Pathway and Experience							VA by Pathway and Experience						
experience	CR	IE	TF	TFA	TL	Other	CR	IE	TF	TFA	TL	Other	
1st year	0	0.005	-0.035	-0.055	-0.015	-0.007	1st year	0.000	-0.009	-0.040	-0.034	-0.021	-0.049
2nd year	0.035	0.031	0.006	-0.015	0.041	0.014	2nd year	0.048	0.045	0.055	0.042	0.034	0.066
3rd year	0.054	0.074	0.039	-0.025	0.047	0.008	3rd year	0.080	0.061	0.053	0.106	0.052	0.059
4th year	0.068	0.088	0.053	-0.011	0.061	0.022	4th year	0.088	0.069	0.061	0.114	0.060	0.067
5th Year	0.077	0.097	0.062	-0.002	0.07	0.031	5th Year	0.091	0.072	0.064	0.117	0.063	0.070
ELA 6-8							Math 6-8						
Average VA by Pathways and Years Since Implementation							Average VA by Pathways and Years Since Implementation						
	CR	IE	TF	TFA	TL	Other	CR	IE	TF	TFA	TL	Other	
1	0	0.013	-0.025	-0.03	-0.005	-0.021	1	0.000	-0.020	-0.012	0.046	-0.018	-0.018
2	0.027	0.029	-0.017	0.027	0.002	0.007	2	0.042	-0.017	0.026	0.056	0.010	0.011
3	0.022	0.018	0.078	0.021	0.011	0.011	3	0.032	0.015	0.067	0.085	0.026	0.034
4	0.017	0.013	0.061	0.018	0.007	0.007	4	0.044	0.029	0.071	0.081	0.037	0.045
5	0.025	0.020	0.065	0.022	0.013	0.012	5	0.047	0.033	0.071	0.082	0.040	0.048
VA by Pathway and Experience							VA by Pathway and Experience						
	CR	IE	TF	TFA	TL	Other	CR	IE	TF	TFA	TL	Other	
1st year	0.000	0.013	-0.025	-0.030	-0.005	-0.021	1st year	0.000	-0.020	-0.012	0.046	-0.018	-0.018
2nd year	0.032	0.032	-0.016	0.033	0.004	0.017	2nd year	0.049	-0.017	0.030	0.057	0.016	0.021
3rd year	0.025	0.017	0.114	0.051	0.017	0.020	3rd year	0.035	0.028	0.091	0.113	0.040	0.056
4th year	0.017	0.009	0.106	0.043	0.009	0.012	4th year	0.054	0.047	0.110	0.132	0.059	0.075
5th Year	0.030	0.022	0.119	0.056	0.022	0.025	5th Year	0.059	0.052	0.115	0.137	0.064	0.080