How Long Do Community Insiders and Outsiders Stay? Mathematics Teacher Preparation and Retention in an Urban School District

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Purpose: Many US school districts currently face teacher-retention issues, raising questions about which new teachers might remain long term in district schools. Positing that a teacher's local ties matter, this quantitative analysis was designed to compare the long-term retention of community-based teachers to community outsiders in the school district that recruited them and subsidized their initial training. **Research Methods/Approach:** To understand the extent to which individual preparation approaches might distribute different retention benefits to different teacher subgroups, the study examined teacher preparation as an interactive system. Drawing on administrative data from New York City Public Schools and project survey data, the study used logistic regression to model the 3-, 5-, and 8-year retention of 617 secondary mathematics teachers who entered teaching through a high-profile alternative teacher-certification program. **Findings:** Community insiders—defined in this study as the graduates of New York City high schools—had markedly and significantly estimated higher odds of district retention than that of community outsiders at all three points in time. Black community insiders who entered teaching with prior career experience were shown to have particularly high odds of retention in the district. **Implications:** The results indicate that the recruitment and development of community-based teachers, and particularly those who are Black career changers, promise to improve retention in district schools. They also support the thesis that retention

Electronically published June 30, 2023

American Journal of Education, volume 129, number 4, August 2023.
 https://doi.org/10.1086/725587

and other program-level outcomes are the product of interactions between certain types of teachers working in particular (e.g., highly racially segregated) schools and the initial training they receive in teacher-certification programs.

Teacher turnover has been a long-standing problem in many US school districts, particularly those that serve lower-income Black and Latinx students (Carver-Thomas and Darling-Hammond 2017). By all indications, turnover will get worse in the post-COVID era (Steiner and Woo 2021). High levels exacerbate teacher shortages in core subject areas such as mathematics (Sutcher et al. 2016), require the investment of limited resources to find replacements, worsen the organizational functioning of schools (Sorensen and Ladd 2020), and stunt student learning (Ronfeldt et al. 2013).

To fill open positions in core subjects, some districts will increase an already substantial reliance on fast-track alternative certification programs such as the New York City Teaching Fellows (NYCTF). In the years leading up to the pandemic, an increasing share of new teachers nationally was entering through alternative certification programs; specifically, about 25% of newly certified teachers, up from about 15% in 2015 (Yin and Partelow 2020). In districts and schools that serve lower-income Black and Latinx students, the proportion of new teachers entering through alternative routes often is well above 50% (Carver-Thomas and Darling-Hammond 2017). Thus, for the foreseeable future, alternative certification programs will continue to play a decisive role in determining who teaches lower-income Black and Brown students in neighborhood urban schools.

Rooted in different theories of action and subjected to varying geographic, demographic, and market forces, different alternative certification programs attract and admit different types of teacher candidates. For example, the Teaching Fellows, Teach for America (TFA), and other so-called selective alternative certification programs recruit heavily from the nation's most selective colleges under

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the assumption that, as high academic achievers, elite college graduates will make particularly effective teachers irrespective of where they teach or how long they stay (Brantlinger 2020; Brantlinger et al. 2022). In contrast, other alternative and nontraditional certification programs specifically recruit and develop community-based teachers, many of whom are Black and Latinx (Carver-Thomas and Darling-Hammond 2017; Gist et al. 2019). Supported by decades of qualitative research, the assumption is that teachers of color with historic and social ties to local schools bring a wealth of knowledge, competencies, and experiences that will enable them to be particularly successful with the Black and Latinx students in neighborhood schools. A second assumption is that, due to their local ties and commitments, community-based teachers will stay in local schools and districts longer than nonlocal teachers, inclusive of most alternative-route teachers recruited from very selective colleges.

However, except for a few suggestive studies (e.g., Dixon et al. 2019), there is little empirical support for the assumption that community-based teachers will stay longer than other teachers in lower-income district schools. To the contrary, some quantitative research suggests that the recruitment of Black and Latinx community insiders may not result in improved retention, at least without first changing the organizational culture of the schools they work in (Grant and Brantlinger 2022; Ingersoll et al. 2019; Simon and Johnson 2015). Recent research (e.g., Carver-Thomas and Darling-Hammond 2017) shows that, nationally, Black and Latinx teachers leave teaching at higher rates than White teachers. This may be because so many begin in underresourced schools with high levels of organizational dysfunction (Simon and Johnson 2015). It may also result from the systemic racism that teachers of color frequently encounter in US schools (Frank et al. 2021).

An issue that hinders our understanding is that prior quantitative studies of retention have not distinguished community insiders from community outsiders—and who is considered a community insider or outsider can vary. Although quantitative studies typically collect information on teacher race, they rarely, if ever, collect information on teachers' status as insiders or outsiders or their rootedness in or social connections to local communities. To our knowledge, no quantitative or mixed-methods study includes measures that would help us understand the comparative retention rates of community insiders and outsiders.

Although research on teacher retention has advanced over time, it has not advanced to the point that one can reasonably predict which early-career teachers are likely to stay. We also know little about how different approaches to and features of initial preparation relate to teacher preparation (Ingersoll et al. 2014). To advance the field, some scholars call for research that treats teacher recruitment, preparation, and school assignments as an interactive system (Donaldson and Johnson 2010; Humphrey and Wechsler 2007; Ronfeldt et al. 2014). This study answers this call by including interaction terms between teacher-, training-,

and school-level variables in models of teacher retention. It also focuses specifically on the retention of two policy-relevant mathematics teacher subgroups and how that seems to be influenced by their interactions with initial training in the NYCTF program and their first schools in the NYC public school system. These two subgroups specifically are White first-career teachers from the nation's most selective colleges and Black second-career teachers who were themselves graduates of NYC high schools. Whereas members of the Black teacher subgroup were insiders in the sense that, prior to NYCTF, they had lived and attended school in NYC, all members of the White teacher subgroup appeared to be unfamiliar with NYC public schools and, in this sense, were outsiders. With this in mind, we believe this is the first quantitative analysis of teacher retention to distinguish between community insiders and community outsiders, and we report findings about their relative lengths of service in the district that facilitated their entry into full-time paid teaching and subsidized their master's certification program.

Background and Framework

This literature review summarizes what the field knows about the relationship between teacher retention and teacher recruitment, preparation, and first-school placements. It contextualizes the current study and provides a rationale for the inclusion of many study variables and the examination of their interactions.

Teacher Recruitment and Retention

In making recruitment and admission decisions, teacher-certification programs frequently consider such teacher characteristics as race, gender, age, academic credentials, and prior experience (Van Overschelde and Wiggins 2020). By examining the influences of these and other teacher characteristics, large-scale studies provide insights about the relationship between teacher selection (into any certification program) and retention.

Many programs consider an applicant's race and ethnicity in making admissions decisions. This may influence program-level retention, because teachers from different racial and ethnic backgrounds have been shown to exhibit significantly different rates of retention. Specifically, recent studies show that, nationally, Black teachers have higher rates of attrition than White teachers (Carver-Thomas and Darling-Hammond 2017; Ingersoll et al. 2019; Nguyen et al. 2020). Sun (2018) found that this result also held in North Carolina but argues that it was due to the fact that, compared with White teachers, Black teachers received less formal preservice training and were more likely to begin in high-turnover schools. Further, differences in the retention of Black and White teachers seem to vary by locale; in

apparent contrast to the national pattern, in Texas and Georgia, Black teachers have been shown to exhibit better rates of retention than White teachers (Scafidi et al. 2007; Van Overschelde and Wiggins 2020).

As indicated, some "selective" programs actively recruit graduates of highly selective colleges. Although the evidence of their instructional effectiveness is mixed (e.g., Brantlinger and Griffin 2019), such teachers have been found to leave teaching at higher rates than those from less-selective colleges (Boyd et al. 2005; Kelly and Northrup 2015). However, rather than being an effect of college selectivity, this may be because so many elite college graduates enter teaching through selective, fast-track programs such as TFA and the Teaching Fellows—programs that facilitate an easy entry into, and possibly also out of, teaching (Brantlinger 2020; Carver-Thomas and Darling-Hammond 2017; Redding and Smith 2016). It also may be because elite college graduates tend to be dissatisfied with teaching as a career choice and have higher-status career alternatives (Brantlinger 2021; Kelly and Northrup 2015). Generally recruited as part of national, rather than local, initiatives, selective college graduates tend to have weak ties to local schools and, hypothetically at least (Boyd et al. 2005), this also may facilitate their exit.

Due to their differing career trajectories and motivations, first- and second-career teachers may exhibit different patterns of retention, although the empirical evidence about this is lacking (see Brantlinger 2021). Some research shows that, in comparison with first-career teachers, second-career teachers enter teaching for different reasons and also interact differently with initial preparation and first-school contexts. Prior career experience may shape their retention-related behaviors in particular, as many career changers are surprised by the working conditions of their first schools and frequently believe that their prior experiences, skills, and wisdom are not valued by administrators and colleagues (Wilkins 2017). Moreover, teachers' prior career experience generally corresponds with their age, as first-career teachers generally enter teaching at a younger age than second-career teachers. And, regarding age, the literature suggests that the youngest and oldest entrants have higher rates of turnover on average than those in their 30s and 40s (e.g., Nguyen et al. 2020). This suggests that second-career teachers, who tend to enter teaching in their 30s or 40s, might have better rates of retention than first-career teachers who generally enter teaching in their early 20s.

Teacher Preparation and Retention

Research on the relationship between teacher preparation and teacher retention is limited, hence "it is difficult to draw firm conclusions" (Ingersoll et al. 2014, 5). Some research suggests that the quantity of initial preparation that new teachers complete prior to entry affects their length of stay (Carver-Thomas and Darling-Hammond

2017; Redding and Smith 2016). Ingersoll et al. (2014) specifically find a positive association between the amount of mathematics teaching methods coursework that mathematics teachers complete during initial preparation and their subsequent retention. However, as these authors observe, few studies examine the relationship between preparation and retention, meaning that such results are more suggestive than "firm." In addition to a lack of studies, a problem is the difficulty of disentangling the effects of recruitment, selection, training, and school assignments on retention. For example, although studies (e.g., Redding and Smith 2016) have shown that alternatively certified teachers leave at higher rates than traditionally certified teachers, it is unclear whether this is due to teacher recruitment, the length or content of initial preparation, or the contexts in which they teach.

Teachers' First Schools and Retention

First school placements form an integral part of the design of most fast-track alternative certification programs in a way that they do not for most traditional certification programs. In consultation with school districts, fast-track programs generally place teachers in particular schools or types of schools. In some cases, alternatively certified teachers have little say about the specific school in which they will first teach. In other programs, such as NYCTF, teachers are restricted to teaching in higher-poverty schools in certain geographic regions or certain types of schools in a district, but they generally find a first school position by interviewing with principals and other administrators.

Numerous studies have examined the relationship between the contexts in which new teachers teach and teacher turnover (e.g., Donaldson and Johnson 2010). A consistent result is that teacher turnover is particularly high in districts and schools that serve low-income and student-of-color populations (Carver-Thomas and Darling-Hammond 2017; Simon and Johnson 2015). An implication is that teachers—the majority of whom are White—leave these contexts due to their dissatisfaction with teaching low-income Black and Latinx students. However, studies that investigate organizational climates suggest that many teacher leavers may depart in response to the "dysfunctional" contexts of schools that disproportionately serve such students (e.g., Grant and Brantlinger 2022; Simon and Johnson 2015). This dysfunction may be related to the emphasis on high-stakes accountability, harsh disciplinary policies, and high turnover of teachers and administrators in many of these schools (Garcia and Weiss 2019). Another possibility is that teachers exit lower-income and high-minority schools and districts at high rates because they are not adequately prepared to work with racially and linguistically diverse students and students from low-income and impoverished backgrounds (Ullucci and Howard 2015).

Interactions between Components of Teacher Preparation

Typically, in quantitative analyses of teacher retention, the models are restricted to main effects. However, given the unique way that teachers from different backgrounds might interact with the core components of teacher-preparation programs, it seems warranted to include interaction effects in quantitative retention models (Ronfeldt et al. 2014). To date, a small number of quantitative analyses of retention have examined interactions between teacher characteristics and those of their students, between individual teacher characteristics (e.g., race and gender), and between components of teacher preparation (e.g., fieldwork and methods courses). They do this either by including interaction terms in retention models or by disaggregating outcomes for different kinds of teachers.

Two studies investigate how interactions between features of initial preparation shape teachers' actual or intended retention. Ingersoll et al. (2014) consider how interactions between teacher preparation and teachers' subject-matter assignments (i.e., mathematics, science, other) moderate the effects of preparation on teacher retention in their current school. In an end note, they report that very few interaction effects were statistically significant, and, therefore, they do not discuss any in particular. However, based on the lack of significant interactions, they conclude that the likelihood of attrition of mathematics teachers who entered with an education degree was not different than those who entered with a noneducation degree. They also found a positive association between the number of mathematics teaching methods courses that mathematics teachers completed during initial preparation and their subsequent retention.

Ronfeldt et al. (2014) examine how interactions between teaching methods courses and student teaching influence preservice teachers' plans to stay in teaching. They found that "the relationship between practice teaching and teachers' persistence is stronger among teachers with fewer methods courses and vice versa, suggesting that practice teaching and methods courses are substitutes to some extent" (Ronfeldt et al. 2014, 3–4). The evidence accumulating across these studies of interactions suggests that the relationship between interactions among different components of teacher preparation and teacher retention may depend on the program and types of teachers.

Two studies evaluate whether the interaction between teachers' race and gender was associated with their retention. Kirby et al. (1999), looking at Texas schools, found few gender-race subgroup differences among early-career teachers, but that experienced White female and Black male teachers were more likely to leave teaching than other teachers with similar levels of experience. Using disaggregation instead of including interaction terms in models, Ingersoll et al. (2019) ran separate retention models for non-White and White teachers and found that, nationally,

Black female teachers were more likely to be retained in teaching than Black male teachers.

Two regional retention studies examine the interaction between teacher race and the race of students in their schools, sometimes called racial matching. Scafidi et al. (2007) specifically found that Black elementary teachers in Georgia were significantly less likely than their White counterparts to leave schools with high proportions of Black students. Sun (2018) reports similar results for elementary and secondary teachers in North Carolina. In an analysis including explicit interaction terms for race and teacher effectiveness, she also found that more effective Black teachers were more likely to be retained than less effective Black teachers.

In a study of North Carolina teachers' mobility and retention over a decade-long period, Guarino et al. (2011) uniquely include a large number of interaction terms in their models of teachers' mobility patterns. Their purpose was to examine how teacher characteristics (e.g., race) and qualifications (e.g., experience, college selectivity) interact with student demographics. At the broadest level, they found that schools that serve high proportions of non-White and low-income students attract lower percentages of new teachers with desirable qualifications and that those schools also lose their teachers with desirable qualifications to other schools.

In sum, the cited literature generally points to the promise of examining teacher preparation as an interactive system and, in particular, of including interaction terms in statistical models of teacher preparation. Some of the literature shows how an analytic focus on teacher subgroups could improve our understanding of the retention of particular kinds of teachers or teachers with certain characteristics. The current retention study is designed to contribute to this literature by examining teacher preparation as an interactive system and, as part of that, examining whether members of a Black community-insider subgroup and members of a White community-outsider subgroup working in similar school contexts might benefit differently from the same initial training.

Theoretical Perspective

As indicated, investigating how different subgroups of early-career teachers interact with teacher preparation and the students they teach is seen as a promising way to advance research. Ronfeldt et al. (2014) observe that the retention literature lacks "deliberate programs of research that examine whether the same features of preparation have similar benefits across . . . their graduates" (5) and call for researchers to consider teacher preparation "as a system of interacting features where the effects of any given feature is examined in relationship to others" (39). Following Ronfeldt et al. (2014) and others (Donaldson and Johnson 2010; Humphrey and Wechsler 2007), we posit that the other outcomes of teacher-preparation programs can be thought of as the product of interactions between

teacher subgroups working in particular school contexts and the training they receive in teacher-certification programs. Using retention as the rubric, a question is whether the same main features of initial training exhibit differential benefits across different teacher subgroups. Large-scale qualitative studies of early-career teachers show that certain program features (e.g., practicum seminars, training in classroom management) meet the felt needs of certain kinds of teachers working in certain school contexts and fail to meet those of others (Humphrey and Wechsler 2007).

For the purposes of this study, three types of two-way interactions are of theoretical interest: those between (1) teacher subgroups and training, (2) teacher subgroups and schools, and (3) training and schools. Two mathematics teacher subgroups, among others, also recruited by NYCTF, also are of particular interest: nationally recruited White teachers from very selective colleges and locally recruited Black career changers. As indicated in the article's introduction, our interest in these teacher subgroups results from the fact that both have been the focus of policy initiatives designed to improve organizational functioning and outcomes in schools that serve low-income Black and Latinx students.

Research Questions

This study addresses three research questions about the retention of secondary mathematics teaching fellows (SMTFs) who entered paid teaching in the NYC public school district through NYCTF in either the 2006–07 or 2007–08 school year:

- What is the relationship between SMTFs' background characteristics and their retention in district schools?
- To what extent are different approaches to initial training for secondary mathematics within NYCTF associated with different levels of SMTFs' district retention?
- How does the district retention of a community-insider and a community-outsider subgroup compare when receiving the same initial training and working in similar first-school contexts?

The first question addresses our interest in how the selection of mathematics (and other) teachers contributes to program-level retention outcomes. The second question leverages the fact that NYCTF's university partners for master's certification coursework in secondary mathematics varied in the emphasis they placed on subject-general and mathematics-specific training. The third question examines the extent to which, using retention as the rubric, two policy-relevant mathematics

teacher subgroups respond differently to individual approaches to secondary mathematics teacher training provided by NYCTF's university partners. Specifically, these two subgroups are Black community-based teachers and White recent graduates of very selective colleges who did not graduate from a NYC high school.

Methods

To answer the research questions, we merged survey data that we collected from SMTFs with their service-history data provided by the NYC Department of Education (NYCDOE). We used these data to quantitatively model their district retention using teacher, training, and school variables and the interactions between them. Although grounded in the retention literature, the analysis was exploratory, because the field knows so little about the relationship between the features of teacher preparation associated with teacher retention and about the ways in which kinds of teachers might interact differently with the same preparation features. Because their theoretical identification was not possible in advance, the analysis used a stepwise procedure designed to identify which of the main variables and interactions between them seemed to best explain SMTFs' district retention.

Study Context and Participants

Launched in 2000, NYCTF was the flagship Teaching Fellow program. At that time, district and state leaders expressed concern about teacher quality, particularly the large numbers of uncertified teachers teaching in NYC schools. NYCTF and other selective programs were designed, in part, to replace uncertified teachers with alternatively certified teachers who were better qualified academically, under the assumption that this would lead to improved student outcomes (Brantlinger 2020). For these reasons, and concerns about the overall lack of SMTF preparedness and commitment to district schools (Brantlinger et al. 2022), NYCTF was chosen as a research site by a research team led by the first and third study authors.

The study participants include 617 SMTFs who entered NYCTF in either June 2006 or June 2007. According to lists provided by NYCTF and NYCDOE, the participant group included more than 95% of all SMTFs who began as teachers of record in NYC public schools in fall 2006 or 2007. These SMTFs entered teaching after completing 120 hours of university coursework, 40 hours of practice teaching in a summer-school classroom, and 34 hours of Fieldwork Advisory coupled with 6 additional hours of NYCTF-delivered training (Brantlinger and Smith 2013).

As with other teacher novices (see Goldhaber and Theobald 2022), local labor-market conditions may have influenced SMTFs' decisions to enter and

stay in NYC public schools. Those in this study were in the induction phase when the Great Recession began; NYC added jobs until September 2008 and, following that, lost jobs in a range of sectors including those that, like teaching, required a college degree (e.g., investment banking, law) (DeFreitas 2009). These economic trends appeared to have animated some of the study teachers to enter and remain in teaching until more attractive employment opportunities reappeared (see Hurst and Brantlinger 2022).

Table 1 describes the sample. Although ethnically and racially diverse, SMTFs were majority White. A slim majority (51.5%) were female. About one-third graduated from an undergraduate institution ranked as "most competitive" (i.e., very selective) using Barron's 2007 college rankings. Less than a third of SMTFs completed a postsecondary degree in mathematics or another STEM field prior to entry. Most (72.2%) graduated from a high school located outside of the city and were, in this sense, considered to be community outsiders in this study.

In this period, four local universities provided master's certification coursework for SMTFs. SMTFs' place of residence was used to assign them to one of these campuses. The emphasis that the university partners placed on mathematics varied substantially by campus (Boyd et al. 2012; Brantlinger and Smith 2013). Specifically, at two universities, more than 65% of the courses were mathematics teaching methods or mathematics content courses, whereas at the other two, this held for only 35–45% of the courses. Therefore, we characterized training at the first two universities as mathematics specific and that at the second two as subject general. As table 1 indicates, combined, the colleges that provided mathematics-specific training prepared the majority of SMTFs.

Fieldwork Advisory served as a practicum forum for SMTFs to reflect on their experiences with practice teaching in summer-school classrooms and to discuss chapters from TNTP's (2005) *Teaching for Student Achievement Guidebook*. The guidebook covered ostensibly "proven" techniques for raising student achievement and implementing classroom routines and management. It was subject general and generally more consistent with the subject-general certification coursework than the mathematics-specific certification coursework (Brantlinger and Smith 2013). Although held on the partnering campuses, Fieldwork Advisory was organized and staffed by NYCTF rather than the universities.[1] There were approximately 20 SMTFs in each advisory section and 31 total advisory sections across the two cohorts.

After the summer preservice program in 2006 or 2007, the 617 SMTFs began teaching in either a middle or high school (206 total middle schools and 149 total high schools). These schools differed in the degree to which they were racially and economically segregated. In 19.4% of the schools, more than 98% of the students were Black or Latinx, and in 14% of the schools, more than 95% of students received subsidized lunch (table 1). In their first 2 years, SMTFs taught full time while continuing to take coursework at the NYCTF

TABLE 1

Descriptive Statistics for Select Study Variables

Variables	Categories	Proportion in Sample (%)	8 Years Retention in District (%)
Entire sample:		100	37.9
Teacher:			
Gender	Female	51.5	39.5
	Male	48.5	36.2
Age (at entry)	21–23 years	32.8	30.0
	24–27 years	32.3	41.0
	≥28 years	34.9	42.6
Race/ethnicity	White	53.7	36.3
	Asian	16.0	27.3
	Black	21.0	52.3
	Latinx	9.4	32.8
High school location	In NYC	27.8	53.5
	<100 miles to NYC	27.5	36.9
	≥100 miles to NYC	44.8	29.2
College selectivity	Less selective	40.2	43.7
	Moderately selective	26.2	43.8
	Very selective	33.6	25.4
Training:			
University coursework	Math specific	62.7	41.1
	Subject general	37.3	36.0
Fieldwork Advisory	Low rated	74.0	34.6
	High rated	26.0	47.2
Initial certification	Grades 7–12 math	56.8	38.4
	Grades 5–9 math	43.2	37.3
School:			
Subsidized lunch rate	≤95%	86.0	40.3
	>95%	14.0	23.0
Black and Latinx students	≤98%	80.6	39.8
	>98%	19.4	30.0

NOTE.—$n = 617$. However, six to eight teachers were missing data for high school location, college selectivity, and postsecondary degree. The second column includes information about 13 of the 20 candidate variables included in the analysis. Not included are the variables teacher postsecondary degree and, under training, cohort (i.e., year of entry), as well as the following school-level variables: student enrollment, student attendance, student suspensions, student stability, English Learners, and middle or high school level. NYC = New York City.

partner universities. Although not the focus of this study, SMTFs received varying amounts of mentoring and induction support in their first 2 years. Prior project research shows that SMTFs received varying amounts of induction support (Foote et al. 2011) and that the frequency of their first-year meetings with an assigned mentor was positively associated with their district retention at 5 years (Brantlinger et al. 2022). That said, we did not include the induction measures in this analysis, given our specific theoretical interest in interactions between training, teachers, and characteristics of students in the teachers' first schools. Mann Whitney U tests showed that our categorical measures of the amount of induction and mentoring support received did not vary significantly in association with any of the teacher, training, and school variables included in this analysis.

Data and Measures

Teacher survey data.—The study draws on data from three waves of surveys administered to SMTFs from NYCTF's 2006 to 2007 summer cohorts. The first survey was administered at the end of NYCTF's summer preservice program in 2006 or 2007, the second a year later in either 2007 or 2008, and the third in 2016. The first survey, completed by 435 SMTFs, collected their evaluations of NYCTF's Fieldwork Advisory. Of the 617 mathematics teachers in NYCTF's summer 2006 or summer 2007 cohorts, 585 completed at least one survey, which means that we had close to 95% response rate for the teacher-level measures. Further, administrative files provided by NYCTF's university partners allowed us to fill in missing teacher-level data for 21 of these teachers. The 13 remaining teachers with missing teacher-level data were listwise eliminated from the analysis.

Retention data and measures.—The NYCDOE provided teachers' district service-history (i.e., retention, role, and school assignment) data covering the period from 2006 to 2016. These data, which included at least 8.4 years of service data for more than 95% of the SMTFs, were used to create dichotomous variables for their retention in the district at 3, 5, and 8 years. Eight years was selected based on the temporal limits of the data, and 3 and 5 years because they are common referents in the literature as major points in a teacher's career trajectory. Although all SMTFs began as secondary mathematics teachers, the retention measures referred to retention in any paid role in the district; of the 38% who remained in the district after 8 years, about 79% were teachers, 19% were full-time administrators, and less than 2% held positions such as school psychologist (see Brantlinger 2021). Naturally occurring breaks in the service-history data allowed us to choose cut points of 2.9, 4.9, and 7.9 years in creating the dichotomous retention variables. In particular, no SMTF had service-history data that fell between 2.7 and 2.9 years

nor 4.7 and 4.9 years, and only 2 had a total amount between 7.7 and 7.9 years. Thus, these cut points distinguished SMTFs who left the district just after completing 3, 5, and 8 years from those who completed more than 3, 5, or 8 full years.

Teacher measures.—The categorical variables for (undergraduate) college selectivity, postsecondary degree (in STEM), and high school location were constructed from survey data. Three waves of surveys meant that we had complete information for 95% of the entries for these measures. Barron's 2007 ranking system was used to distinguish between very selective institutions (i.e., the highest ranked), moderately selective institutions (i.e., those that were ranked above the lowest but below the highest), and less-selective institutions (i.e., those not on Barron's list or with the lowest rankings). For the high school location variable, we created a categorical variable that distinguished between SMTFs who graduated from a high school (1) located in NYC, (2) outside but within 100 miles of NYC, and (3) farther than 100 miles from NYC. The cut point of 100 miles was chosen principally due to a natural break in the data: all but five high schools were located less than 95 miles from the city limits or more than 110 miles from it. In addition, depending on the direction, the NYC metropolitan region extends roughly about 80 miles from the city proper in some directions and 110 miles in others (Census Reporter 2021).

NYCDOE's service-history file provided information about teacher gender and teacher race, distinguishing between Latinx and non-Latinx teachers, and categorizing the latter as White, Black, Asian, or "Mixed." Demographic information from study surveys was used to recategorize those SMTFs labeled as mixed as either Black or Asian. We used the teachers' self-reported demographic data on surveys to recategorize as either Black or Asian the approximately 3% of mixed teachers in the sample. There were too few mixed-race teachers to justify adding the category to the teacher race measure, as interaction terms involving this measure would involve parsing the already small number of mixed-race teachers into smaller subgroups. And, rather than recategorize them as White, we assumed that individuals who identified as part Black or part Asian might face the kind of racial bias in schools as people who identify as fully Black or Asian (see Frank et al. 2021). Table 1 provides information about teacher-level variables and some associated descriptive statistics.

Training measures.—NYCTF provided information on the university assignments, Fieldwork Advisories, and initial certification of all 617 SMTFs (see table 1). The 435 SMTFs who took the first survey evaluated the quality of their Fieldwork Advisory, one of 31 sections across the two cohorts, using a 5-point scale that ranged from "strongly disagree" (a 1) to "strongly agree" (a 5). (A limitation was that missing data across the sections ranged from 9 to 37%.) Gaps in the mean evaluation scores for the advisory sections were used to distinguish between those that were high rated and low rated; on average, teachers from the eight top-rated groups "agreed" (with average means near 4 on the 5-point scale) that their

advisory section helped them "to understand [their] clinical fieldwork experiences," "to learn about teaching methods," and "to learn classroom management." In these sections, almost all surveyed SMTFs agreed or strongly agreed that their advisory section was helpful. In contrast, on average, those from the 23 low-rated advisories "neither agreed nor disagreed" (with means near 3 on the 5-point scale) with these statements, with about equal numbers "disagreeing" as "agreeing."

Measures of first-school context.—NYSED provided data for the teachers' first-school context, including (1) school enrollment, (2) student attendance, (3) student suspensions, (4) subsidized (i.e., free or reduced-price) lunch, (5) English Learners, and (6) Black and Latinx students.[2] Data from either 2006–07 or 2007–08 were used corresponding with individual SMTFs' year of entry. In eight cases, SMTFs switched schools during the first semester of the first year. As such, data from their second school were used. The conversion of continuous to categorical variables was appropriate, as all six school-level variables were either highly skewed negatively (e.g., subsidized lunch) or highly skewed positively (i.e., school enrollment). Cut points of either one standard deviation above or below the mean were used in most cases, creating a large referent group and a smaller comparison group (table 1). The literature and prior project research helped us to determine whether to use a cut point of one standard deviation (SD) above or below the mean. For example, because the literature finds that teacher turnover is particularly high in "high-minority" schools, we selected one SD above for the "Black-Latinx student" measure. We note here that we used the combined Black-Latinx student measure instead of using two separate measures precisely because "percent Latinx student" (not included in the main analysis) was strongly correlated with the "percent English Learner" (included in the main analysis), whereas the "percent Black-Latinx student" measure was not (correlation coefficients of 0.51 and 0.08, respectively). In a post hoc analysis, we reran the stepwise procedure replacing percent Black-Latinx student and percent English Learners with percent Black student and percent Latinx student. Here, the stepwise procedure failed to identify either percent Black student or percent Latinx student for inclusion in any retention model.

Analysis

Because the field lacks a substantiated theory of how the recruitment, training, and school assignments of teachers interact to shape their retention, this quantitative analysis was exploratory. A stepwise analysis was designed to build, rather than test, retention models that included both main and two-way interaction effects. Logistic modeling was selected because retention at a given point in time is a binary outcome (Pampel 2000). SPSS software was used to estimate the coefficients of the models predicting the likelihood of individual SMTFs remaining in the district at 3, 5, and 8 years. These models were estimated as

$$\ln\left(\frac{\hat{p}}{1-\hat{p}}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_{12} X_1 X_2 + \beta_{13} X_1 X_3 + \beta_{23} X_2 X_3. \quad (1)$$

The coefficients β_i represent the expected change in the retention outcome (in log-odds units) for individual SMTFs provided vectors for SMTF characteristics/recruitment (X_1), NYCTF training (X_2), and first schools (X_3). The model includes the three two-way interaction vectors for the pairwise interactions between individual variables at the teacher, training, and school levels. The final model includes an exponentiation of the coefficients to estimate the odds ratio, or likelihood, of individual SMTFs leaving the district for a one unit change in each variable.

The candidate main effect variables at the teacher and school levels were chosen theoretically, based on the retention literature (e.g., Ingersoll et al. 2019), and the training variables were informed by prior project research on NYCTF (e.g., Meagher and Brantlinger 2011). As indicated, we included interaction terms due to our theoretical interest in examining teacher preparation as an interactive system. However, the literature has not advanced to the point where we could be confident about which main effects to include, much less the kinds of two-way interaction terms that might be predictive of teacher retention. Therefore, to select from the many possible combinations of study variables and two-way interactions between them that might be predictive, the analysis used a logistic stepwise procedure (Bursac et al. 2008; Zhang 2016). The procedure helps to achieve parsimony in model building, which requires that researchers "choose from a large set of covariates those that should be included in the 'best' model" (Bursac et al. 2008, 1). The stepwise procedure is designed to maximize the model fit and minimize the potential impact of multicollinearity, incorporating information beyond the statistical significance of variables. Bursac et al. (2008) show that, given a list of possible explanatory variables, the stepwise approach is more likely than not (about 70%) to arrive at the "best" or "optimal" logit model when there are more than 360 observations. (In this study, there are 606 observations.)

In the current study, the goal was to use stepwise regression to arrive at optimized logit models of SMTFs' district retention. Using SPSS, the 20 main effect candidate variables were first tested for inclusion in three blocks: one each for the school-, training-, and teacher-level variables. Nine were significantly ($p < .05$) associated with at least one of three retention outcomes, namely:

- Age, race, college selectivity, and high school location (teacher block),
- Fieldwork Advisory and university training (training block), and
- Student attendance, subsidized lunch, and Black-Latinx students (school block).

The 11 nonpredictive variables were excluded from the subsequent analyses. Next, we used an automated logistic stepwise procedure in SPSS that identified

which of these 9 main effects and 36 two-way interaction effects belonged in the optimized models of SMTF retention. In particular, the candidate variables listed above were entered in three blocks. Block 1 included 5 variables prespecified for inclusion regardless of their statistical significance in the final model (based on their theoretical importance): teacher race, college selectivity, university training, subsidized lunch, and Black-Latinx students. Block 2 included the 4 remaining main effects (i.e., age, postsecondary degree in mathematics, Fieldwork Advisory, and initial certification), and Block 3 included the 36 interaction effects. A forward stepwise selection method was used for the inclusion and removal of Blocks 2 and 3 variables in the finalized retention models (Bursac et al. 2008; Zhang 2016). The probability of stepwise entry was set at the 0.05 level and the probability of stepwise removal at the 0.10 level using the Wald test of significance. Missing data were eliminated listwise in the analysis; the models included 97.7% (or 606) of the observations, with missing data appearing to be random.

Finally, in terms of model specification, the clustering of SMTFs in first schools was too small to support the use of hierarchical logistic models. Intraclass correlations showed that, for the three retention outcomes, the proportion of variance accounted for by the clustering of teachers in schools was less than 5%. This reflected the fact that more than half (55%) of SMTFs began teaching in a school with no other first-year SMTFs, 26% started with one other first-year SMTF, and 19% started with two or more first-year SMTFs. As a further robustness check in supplementary analyses, the final models (table 2) were rerun using cluster-robust standard errors. The coefficients and significance levels of effects in the clustered and nonclustered models closely matched and hence supported similar conclusions. For this reason, the original models created using the stepwise model-building procedure were retained.

Insider and Outsider Subgroups

As indicated, theoretically, we were interested in whether single approaches to initial teacher training in NYCTF distributed similar or different retention benefits to distinct teacher subgroups. Practically, due to our interest in the aforementioned policy debates about whom to recruit to teach mathematics and other subjects in low-income and high-minority schools, we wanted to use the modeled results to compare (1) the retention of new teachers who were recruited as part of national recruitment campaigns on the nation's most selective colleges and were likely unfamiliar with NYC public schools with (2) the retention of new teachers who had attended high school in the city and, in this sense, might be seen as insiders in city schools.

TABLE 2

Logistic Regression Models Predicting SMTF District Retention (Odds Ratios)

			3 Years	5 Years	8 Years
Teacher	Race/ethnicity	Asian	.860	.523*	.653
		Black	1.766*	1.840*	1.482
		Latinx	.789	.754	.482*
	High school location	Near NYC	.518*	.655^{+}	.525*
		Far from NYC	.578*	.468**	.390**
	College selectivity	Moderate	1.313	1.168	.964
		Very	.603*	.541**	.518*
	Age (at entry)	24–27 years			2.527*
		≥ 28 years			2.687*
Training	Math specific		1.078	.960	2.136^{+}
	Fieldwork Advisory top		1.803**	2.034**	2.413*
	Math specific × Fieldwork Adv. top				.320*
Teacher × Training	Math specific × age 24–27 years				.467
	Math specific × age ≥ 28 years				.368*
	Fieldwork Adv. top × coll. sel. moderate				1.661
	Fieldwork Adv. top × coll. sel. very				3.844*
School	Subsidized lunch > 95%		.712	.583*	.481*
	Black-Latinx student > 98%		.641^{+}	.690^{+}	.754
Constant			3.614**	2.000**	.636
n =			606	606	606
Nagelkerke R^2			.105	.166	.200

NOTE.—SMTF = secondary mathematics teaching fellow; NYC = New York City.
$^{+}$ $p < .10$.
* $p < .05$.
** $p < .01$.

The stepwise analysis showed that the teacher-level measures of high school location, teacher race, college selectivity, and teacher age were predictive of the teachers' district retention, and we understood that we could use them to construct a typology of teacher subgroups including some that were relevant to debates about whom to recruit to teach in neighborhood urban schools. Specifically, we used high school location as the primary indicator of a teacher's status as an insider or outsider to city schools. This measure indicated whether a teacher had lived in the city as an adolescent and, at least at one point, had close ties to New Yorkers. Our use of it as a proxy for a teacher's status as a district insider or outsider is consistent with the "draw of home" study (Boyd et al. 2005) that showed that, in the state of New York, new teachers express a preference to teach in schools close to where they grew up or in schools with similar student demographics. We used the teacher race measure as a second-order indicator of a teacher's status as an insider or outsider, assuming that it signaled a teacher's ethnoracial and cultural affiliations with the predominantly Black and Latinx students in neighborhood NYC public schools.

This assumption is consistent with the teacher-like-me literature (e.g., Redding 2019) and a small number of retention studies that show, for example, that Black teachers are more likely than White and other non-Black teachers to stay in schools with high proportions of Black students (e.g., Scafidi et al. 2007; Sun 2018). In addition, the college selectivity measure was used to distinguish elite college graduates from others, and the teacher age measure was used to distinguish recent college graduates who entered teaching between the ages of 21–23 from career changers who entered teaching at 28 years or older.

As part of the presentation of results, we used the finalized regression models (table 2) to estimate the district retention outcomes of two specific teacher subgroups: White Young Elite Graduate Outsiders (WYEGOs) and Black Career Changing New Yorkers (BCCNYs). As the name suggests, WYEGOs are White teachers who graduated from a very selective college, graduated from a high school located more than 100 miles from NYC, and entered teaching between the ages of 21 and 23. Having graduated college within 3 years of entry, all WYEGOs were considered recent college graduates by NYCTF and the US Department of Education (Henke et al. 2001). BCCNYs were Black graduates of NYC high schools from less- or nonselective colleges. Entering at 28 years or older, all 19 BCCNYs were considered career changers by NYCTF and the US Department of Education. A separate project analysis (Brantlinger 2021) showed that, with a few exceptions, the NYCTF teachers who entered at 28 years or older were employed in a field outside of education for at least 5 years—most for at least a decade—prior to becoming teachers.

Consistent with the introductory sections, WYEGOs and BCCNYs are policy-relevant subgroups. Specifically, WYEGOs are the type of teacher targeted as part of "best and brightest" teacher-recruitment organizations (e.g., TFA), whereas BCCNYs are the type of teacher sought by community-based recruitment initiatives. Although other NYCTF teacher subgroups (e.g., career changers of various stripes) would be of interest to policy makers and scholars, a discussion of those groups is beyond the scope of this article.

Results

At the broadest level, the results of the stepwise analysis showed that the odds of community insiders (i.e., the graduates of NYC high schools), particularly Black community insiders, remaining in NYC public schools were significantly higher than those of community outsiders, including the graduates of high schools located within 100 miles from NYC and also located further than 100 miles from the NYC city limits (table 2). In terms of the interactivity-of-teacher-preparation thesis, there were three significant interaction effects in the 8-year retention model but none in the 3- and 5-year models. This suggested that, in their relationship to alternatively certified mathematics teacher retention, the different

components of teacher preparation form an interactive system in the longer term but perhaps less so in the shorter term. With this in mind, the three subsections that follow address the three research questions in order.

Teacher Selection and District Retention

Looking at the main effects in table 2, teacher race, high school location, college selectivity, and age were all significantly associated with at least one of the three retention outcomes. This suggested that teacher selection (i.e., of teachers with certain characteristics) had an independent effect on the teachers' longer-term retention in the district above and beyond those of initial training and school context. It also supported the idea that the kinds of mathematics teachers that certification programs attract and select can significantly affect program-level outcomes such as retention.

Starting with teacher race and ethnicity, Black SMTFs exhibited significantly higher rates of 3- and 5-year retention than White SMTFs. By extension, these rates also were higher than those of Asian and Latinx SMTFs. The 3- and 5-year retention models specifically estimated that, after controlling for other teacher characteristics and also initial training and first-school contexts, the odds of Black teachers remaining in the district at 3 and 5 years, respectively, were 76.6% and 84.0% higher than those of White teachers. In contrast, Asian SMTFs exhibited significantly lower estimated odds of 5-year retention than White teachers; the estimated odds of Asian SMTFs remaining in the district at 5 years were 52.3% those of White SMTFs. Latinx SMTFs exhibited significantly lower rates of 8-year retention than White SMTFs; the estimated odds of the former remaining in the district at 8 years were 48.2% those of the latter remaining.

Being a community insider significantly and markedly increased the odds of an SMTF remaining in the district at 3, 5, and 8 years. Looking at the 8-year model, the estimated odds of an NYC high school graduate remaining were more than double (a ratio of 1 to 0.390) those of SMTFs who graduated from a high school located 100 miles outside the city and were almost double (a ratio of 1 to 0.525) those of SMTFs who graduated from a high school within 100 miles of the city limits.

College selectivity was also significant in all three retention models. In particular, the models estimated that, in comparison with those of their counterparts, the estimated odds of very selective graduates remaining at 3, 5, and 8 years were all less than two-thirds, respectively, at 0.608, 0.541, and 0.518. The predictivity of college selectivity and high school location in all three models suggested that college selectivity has an effect on teachers' district retention that is independent of that of a teachers' status as a community insider or outsider. As discussed in the discussion section, this has implications for the strategy of recruiting mathematics teachers from the nation's most selective colleges.

Further, SMTF age was predictive in the 8-year model of retention. Controlling for initial training and first-school contexts, the estimated odds of SMTFs who entered between the ages of 21 and 23 remaining at 8 years were less than half of those of their older counterparts (odds ratios of 1 to 2.567 for those who entered at 24–27 years and 1 to 2.678 for those who entered at 28 years or older). To be clear, the stepwise procedure did not select "SMTF age" for inclusion in the 3- and 5-year models. The implication was that teachers' age at entry was predictive of their longer-term retention but not their short-term retention in the district.

Initial Training and District Retention

This section examines the table 2 models through the lens of fast-track training. The models showed that NYCTF training exhibited both shorter- and longer-term effects on district retention and also suggested that the quality and the content of NYCTF training both seemed to contribute to this. In terms of the first point, although the effects of initial training associated with SMTF retention might have dissipated as the years progressed, this was not the case. "Fieldwork Advisory" was significantly associated with the teachers' district retention at 3, 5, and 8 years, and "University coursework" was significantly associated with the teachers' retention at 8 years but not 3 and 5 years.

Second, the models suggested that both the quality and content of training were related to SMTFs' district retention. Specifically, in support of the quality claim, high-rated Fieldwork Advisories were associated with significantly better district retention outcomes at 3, 5, and 8 years than were low-rated Fieldwork Advisories. Recall that SMTFs assigned to high-rated advisories generally agreed that it helped them make sense of their practice-teaching experiences and learn subject-general teaching methods (e.g., techniques for classroom management and teaching to state-mandated tests), whereas SMTFs assigned to low-rated advisories generally were less likely to agree with, or were ambivalent about, this.[3]

The predictivity of university training in the 8-year model indicated that the content of NYCTF training influenced the teachers' longer-term retention. However, whether subject-general or mathematics-specific university training was associated with superior 8-year retention outcomes depended on how university training interacted with the teachers' age and their assignments to Fieldwork Advisory. Specifically, subject-general training was associated with higher rates of 8-year district retention for SMTFs who entered NYCTF at 28 years or older and were assigned to top-rated Fieldwork Advisories. Reciprocally, mathematics-specific training was associated with higher rates of 8-year retention for SMTFs who entered NYCTF when they were younger than 23 years old and who were assigned to low-rated Fieldwork Advisories. Neither university

training approach was associated with higher rates of 8-year district retention for those SMTFs who entered at 24–27 years old.

The Retention of Insiders and Outsiders: Within- and Between-Group Variance

This section examines whether the same approaches to initial training provided different retention benefits to two policy-relevant teacher subgroups: BCCNYs, a community-insider subgroup, and WYEGOs, a community-outsider subgroup. As indicated, the table 2 retention models allow us to estimate the district retention outcomes for members of different teacher subgroups under certain conditions of initial training and first-school contexts.

Estimates obtained from the regression models (table 2) suggested that BCCNYs would exhibit better district retention than all other NYCTF mathematics teachers combined under most, if not all, of the modeled conditions. A post hoc regression analysis provided direct evidence that this was the case. This analysis specifically included only one teacher-level variable that distinguished between BCCNYs (the comparison group), WYEGOs, and all teachers in the sample (table 3). Together, the main and post hoc analyses indicated that none of BCCNYs' individual characteristics alone accounted for their comparatively high estimated odds of district retention. That is, although Blackness was associated with significantly higher district retention at 3, 5, and 8 years, the main and post hoc models alike indicated that BCCNYs had higher estimated odds of retention than other Black SMTF subgroups and other NYC insider subgroups.

TABLE 3

Post Hoc Models Directly Comparing the District Retention of BCCNYs and WYEGOs (n = *606)*

		3 Years	5 Years	8 Years
Teacher	BCCNY (vs. WYEGO)	4.370**	6.418**	5.169**
	All others (vs. WYEGO)	1.999*	1.992*	1.928^{+}
Training	Math-specific training	1.018	.894	1.023
	Fieldwork Advisory top	1.846**	1.927**	3.424**
	Math specific × Field. Adv. top			.366*
School	Subsidized lunch > 95%	.716	.566*	.487*
	Black-Latinx student > 98%	.704	.754	.783
Constant		1.132	.561^{+}	.305**

NOTE.—BCCNYs = Black Career Changing New Yorkers; WYEGOs = White Young Elite Graduate Outsiders.

$^{+}$ $p < .10$.

* $p < .05$.

** $p < .01$.

In contrast, as suggested by the log-odds ratios well below 1 for the graduates of high schools located more than 100 miles from NYC and very selective colleges in the retention models (table 2), WYEGOs had lower estimated odds of retention than most other SMTF subgroups. Irrespective of training and school assignments, WYEGOs were estimated to be much less likely to remain in the district than BCCNYs and other insider subgroups. Their comparatively low retention estimates reflected the broader results that the graduates of very selective colleges and the graduates of non-NYC high schools were significantly less likely to remain in the district at 3, 5, and 8 years.

Substantial within-subgroup variance in retention outcomes existed alongside the substantial between-subgroup variance associated with initial training and school assignments. Figures 1 and 2 provide a visual representation of the within-subgroup variance for WYEGOs and BCCNYs, respectively. They depict how SMTF subgroup retention varied in accordance with certain approaches to NYCTF training.[4] Figure 1 specifically illustrates that, for WYEGOs who started in typically segregated schools, Fieldwork Advisories appeared to be far more consequential to their retention than university training (comparing solid vs. dotted lines). There was a sizable gap—of 25%—in the retention estimates associated with their assignments to either a high-rated or a low-rated Fieldwork Advisory. In contrast, figure 2 shows that, for BCCNYs who started in typically segregated

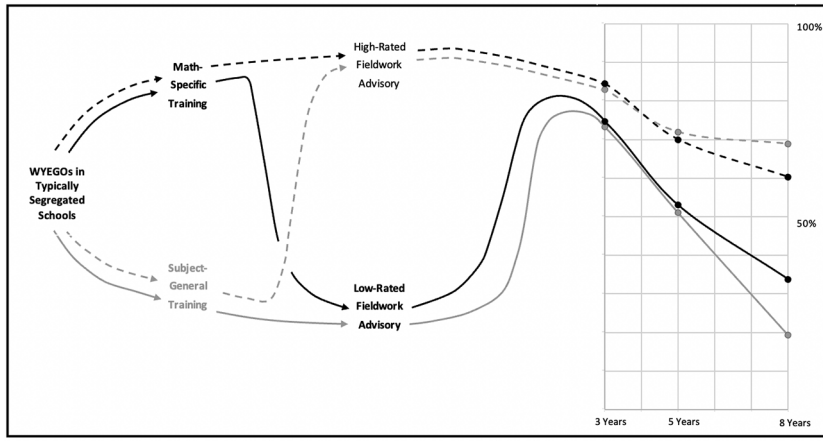

FIG. 1.—Retention estimates by training for WYEGOs in typically segregated schools. Color corresponds with training (black for math specific, gray for subject general); line consistency with Fieldwork Advisory (dotted for high rated, solid for low rated). WYEGOs = White Young Elite Graduate Outsiders.

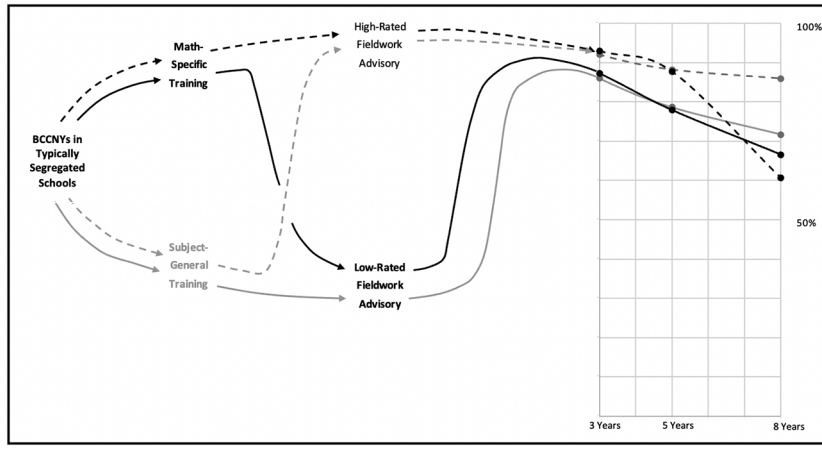

FIG. 2.—Retention estimates by training for BCCNYs in typically segregated schools. Color corresponds with training (black for math specific, gray for subject general); line consistency with Fieldwork Advisory (dotted for high rated, solid for low rated). BCCNYs = Black Career Changing New Yorkers.

schools, the gaps in retention associated with Fieldwork Advisories were similar at 3 and 5 years, but at 8 years, this training component appeared to be more effective for BCCNYs than for WYEGOs. Specifically, for BCCNYs who started in typically segregated schools, subject-general training was associated with better 8-year retention than mathematics-specific training, irrespective of assignment to Fieldwork Advisories.

A comparison of the solid lines in figures 1 and 2 shows that, when controlling for Fieldwork Advisories and school assignments, the estimated 8-year retention odds associated with university training ranged from 19 to 34% for WYEGOs and from 67 to 72% for BCCNYs. The gap between these ranges was 33% (i.e., 67–34%). This suggested that, under certain conditions and district contexts, a fast-track alternative certification program's teacher-recruitment efforts might exhibit a greater effect on its teacher-retention outcomes than specific approaches to teacher training.

Discussion

Practically, the main purpose of this study was to understand how the district retention of community-based teachers or community insiders compares to that of community outsiders. The results were clear. Compared with community outsiders, community-based teachers—defined in this study as the

graduates of NYC high schools—had significantly higher odds of retention in the district at 3, 5, and 8 years. Adding race and age to the mix, we found that Black community insiders who entered teaching at 28 years or older were found to have particularly high odds of long-term district retention in NYC public schools, the district that hired them and subsidized their master's certification. Theoretically and methodologically, the main purpose of this study was to investigate a teacher-preparation program as an interactive system and, as part of that, understand the extent to which single approaches to preparation might distribute different retention benefits to different teacher subgroups. However, as indicated, the results about interactivity were somewhat mixed as only the 8-year model of district retention included significant interaction effects (table 2).

Limitations

This study has several limitations. First, it is possible that none of NYCTF's university partners for secondary mathematics provided high-quality training. Prior project research finds that the training curriculums in NYCTF's Fieldwork Advisories and, to varying degrees, in courses at the NYCTF partner universities promoted deficit views of lower-income students of color (see Brantlinger et al. 2010). Therefore, healthy skepticism is warranted for the results about the relative benefits of NYCTF's mathematics-specific and subject-general training for individual subgroups. Second, the study variables only captured certain features of NYCTF training and first schools. Although six training variables were included in the stepwise analysis, only university training and Fieldwork Advisory were predictive of SMTFs' district retention. Given this, the retention models only very roughly captured the variation and approximated differences in initial training within the NYCTF program. As indicated, other project research shows that not only did the initial training differ at the four different NYCTF partner universities for secondary mathematics but also there were within-campus variations due to such things as multiple sections of the same course being taught differently (Brantlinger and Smith 2013). Additionally, more refined or targeted training measures might have better captured within-NYCTF differences in training. However, whether a larger and more refined set of training measures would have been predictive of SMTF retention is another matter.

Third, the conversion of continuous variables—most of the school-level variables and teacher age—to categorical variables raises methodological issues, in particular concerning the cut points and how this might have affected the automated stepwise selection procedure. Although the determination of the cut points was guided by the literature (in the case of teachers' entry age) and the data itself (e.g., creating teacher subgroups of similar sizes), different cut points might have led to different outcomes. To explore this, several alternative stepwise

procedure analyses were run using variables with different cut points for student attendance and student subsidized lunch. Although the coefficients of those variables changed with each iteration, these changes did not result in different candidate variables being included or excluded from the retention models, nor did it meaningfully change the coefficients and significance levels of other variables.

Fourth, although we were guided by policy debates about what types of teachers should be recruited to teach Black and Latinx students in lower-income neighborhood urban schools, the way in which we constructed the teacher subgroups may have influenced points of emphasis in the interpretation and representation of the study results. We categorized the teachers as insiders and outsiders using the high school location measure (i.e., the location of the high schools that the teachers had graduated from) and then used the teacher race measure to further subdivide the insiders and outsiders into smaller subgroups. Our approach likely misidentified some teachers as outsiders who would be considered insiders in other regards (e.g., long-term residents who moved to NYC after high school) and others as ethnic-racial insiders who might not have been seen that way by their students. Research (e.g., Achinstein and Aguirre 2008) documents Black and Latinx students' suspicion of new teachers who share their racial or ethnic identities but differ from them in terms of social class or language.

Fifth, the use of a stepwise procedure in selecting variables and interaction terms for the retention model raises methodological questions. Smith (2018) critiques stepwise procedures, arguing that "the more variables that are considered, the more likely it is that coincidental statistical relationships will be discovered" (32). He is particularly critical of stepwise analyses that include hundreds of candidate variables. This analysis included far fewer candidate variables, specifically, 20 main effects (step one) and 36 two-way interaction effects. Further, as indicated, the study sample size of 606 teachers appears to be more than sufficient for the stepwise procedure to converge on the optimal model (Bursac et al. 2008). Although it is possible that the study models included coincidental relationships, the significance and directionality of the main effects are consistent with those found in the retention literature.

Sixth, another study limitation is the exclusive focus on district retention. The marked difference between WYEGOs and BCCNYs might look different if we also had accounted for retention in the profession. A companion study sheds light on this. Using career trajectory data from the subsample of 389 study teachers who completed the 2016 survey, that study shows that, about a decade after entry, 31% of very selective college graduates (including WYEGOs) and 64% of Black and Latinx high school graduates from moderately and less-selective colleges (including BCCNYs) remained in NYC public schools, but that 18% of the former and 9% of the latter were working as teachers or administrators in another district or K–12 setting. In other words, for the survey subsample, most of the very

selective college graduates who left the district were not working as a teacher or administrator in another school setting.

Practical Significance

For the foreseeable future, teacher turnover will continue to present a serious challenge for schools that serve lower-income Black and Latinx students (Garcia and Weiss 2019; Sutcher et al. 2016). The COVID-19 pandemic, and general occupational turnover that followed in its wake, will exacerbate the situation, particularly in hard-to-staff subjects such as mathematics. Although there are benefits, such as the replacement of burnouts with new blood, turnover often results in negative consequences for schools and the people in them. High turnover has been shown to limit teacher collaboration and collegiality, institutional knowledge, and students' mathematical growth (Carver-Thomas and Darling-Hammond 2017; Ronfeldt et al. 2013). Hence, it is critically important to find ways to improve teacher retention.

This study clarifies that districts and programs concerned with improving retention would be wise to recruit and develop more community insiders, such as BCCNYs, than they currently do (see also Brantlinger et al. 2023). At the same time, they might devote fewer resources to attracting and training community outsiders, even those who are the high-achieving graduates of very selective colleges. This study and others (e.g., Kelly and Northrup 2015) find that, in comparison to those from less-selective colleges, these teachers leave at high rates. If high-achieving outsiders were to make particularly effective mathematics teachers, then their higher rates of turnover might be acceptable. However, there is growing evidence that selective college graduates are not significantly better at raising students' mathematics achievement than the teachers they teach alongside in low-income, high-minority schools (e.g., Brantlinger and Griffin 2019). Thus, from a district perspective, community insiders such as BCCNYs would seem to be a better investment. And, given the relationship between teacher retention, experience, and effectiveness, they also may lead to improved student outcomes in the long run.

As noted in the introduction, many districts likely will increase their reliance on teachers from fast-track alternative certification programs (Yin and Partelow 2020). With this in mind, the results of this study suggest two particular ways that fast-track training might be modified to improve (mathematics) teacher retention. First, the link between high-rated Fieldwork Advisories and SMTFs' superior district retention indicates that teacher-preparation programs, at least selective and other fast-track programs, should include a practicum seminar that addresses prospective teachers' experiences with practice teaching and their pressing

concerns about teaching. Second, the differential effects that training appears to have on different SMTF subgroups (see figs. 1 and 2) indicates that initial teacher training should be tailored to meet the different needs of different types of teachers working in different types of schools. Of course, additional research is needed to determine how to do this effectively. But, in the absence of empirical evidence, it seems reasonable to suggest that prospective teachers be given options and also be allowed some flexibility in determining the kind of initial preparation they receive.

Significance for Research

As indicated, our understanding of the relationship between initial preparation and teacher retention is limited (Ingersoll et al. 2014). The field knows little about whether initial training distributes different retention benefits to different kinds of teachers working in particular school contexts and, if so, what this might look like (Ronfeldt et al. 2014). Because we could not rely on theoretical or prior empirical information, we used stepwise selection as a way to identify significant main and interaction effects in building models of teacher retention. Although the use of a stepwise procedure for model selection is not uncommon in the hard sciences and medical research (e.g., Zhang 2016), it is rare in education research. There is a general consensus among methodologists that the use of a stepwise procedure makes sense when there are a large number of candidate variables for a model, but there is a lack of empirical or theoretical information about which are likely to be predictive in that model (Bursac et al. 2008; Zhang 2016). With this in mind, and from a validity standpoint, it was encouraging that the three retention models included similarly significant main effects. Of course, the use of a stepwise procedure to identify interaction effects meant that this retention study was exploratory. However, as we argued, a confirmatory study did not make sense given the current underdeveloped state of research on the relationship between initial teacher preparation and teacher retention.

Second, using district retention as the rubric, the results indicated that certain, single approaches to initial training within NYCTF seemed to work better for particular teacher subgroups than they did for others. An implication is that the traditional search for uniformly "effective" or "proven" approaches to initial teacher preparation might be in vain. Training that is judged to be more effective in the aggregate might simply be what works best for middle-class, White teachers who make up the majority in many teacher-preparation programs, inclusive of NYCTF.

Third, the study is fairly unique for drawing on a longitudinal retention data set that linked 8.5 years of service-history data with survey data for hundreds of teachers. Extant studies tend to be either cross-sectional, studying the year-to-year

retention of teachers, or semilongitudinal, tracking cohorts of teachers through their first or second years but not beyond. Although both kinds of studies provide valuable insights about teacher preparation and retention, they leave gaps in our understanding, some of which can only be addressed by longitudinal studies. As an example, this study showed that results about training and retention that hold for teachers in their first few years might not hold as time progresses; in particular, the 8-year model of SMTF retention included significant interaction effects, in particular between the characteristics of teachers and training, whereas the 3- and 5-year models did not.

Notes

This research was supported by the National Science Foundation (NSF grant 1535219 and 1535251).

1. Depending on the year, NYCTF called Fieldwork Advisory either Fellow's Advisory or Student Achievement Framework.

2. Rather than include separate measures for each, there was one variable capturing student race and ethnicity that combined the percentage of Black, Hispanic, and Native American students in a school. Native American students are not named in the variable because their proportion was below 1% in the sampled schools combined. The analysis included a variable for percent English Learners, which, in the NYC context, is highly correlated with a variable for percent Latinx students.

3. A supplementary analysis found that the results of high-rated Fieldwork Advisories were not better explained by the time that SMTFs spent in their summer practice-teaching site or the match between this site and their first school assignments.

4. Figures 1 and 2 are limited to SMTFs who started in typically segregated schools. The corresponding estimated odds of retention for extremely segregated schools were all lower.

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