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## The First-School Retention of Black and Latinx Community-Insiders and Elite College Graduates: Implications for the Recruitment, Selection, and Training of Urban Mathematics Teachers<sup>1</sup>

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**Abstract:** This quantitative study was designed to investigate teacher preparation as an interactive system and examine whether individual approaches to preparation are associated with differential retention benefits across different teacher subgroups. Drawing on longitudinal data on mathematics teachers who entered teaching through the New York City Teaching Fellows (NYCTF) program, the study focused specifically on the first-school retention of two policy-relevant teacher subgroups, namely, (1) the graduates of very selective colleges and (2) Black and Latinx community-insiders. Whereas the latter all attended city high schools, the former generally did not. In part because the

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field lacks a well-substantiated theory of the relationship between teacher initial preparation and their retention, we drew on intersectionality theory and incorporated two-way interaction effects in quantitative models of the teachers' first-school retention. We found significant relationships between NYCTF's initial training and the teachers' retention and, further, that single approaches to initial training appeared to bestow different retention benefits to different teacher subgroups. We also found that the Black and Latinx community-insiders exhibited significantly higher rates of first-school retention than the elite college graduates and, for that matter, other NYCTF mathematics teachers. This result has clear implications for teacher recruitment and training and, in particular, the promise of developing community-based mathematics teachers who resemble the students they teach.

**Keywords:** teacher retention; teacher recruitment; minority teachers; community teachers; intersectional quantitative analysis

### **La retención en la primera escuela de miembros de la comunidad negros y latinos y graduados universitarios de élite: Implicaciones para el reclutamiento, la selección y la capacitación de profesores urbanos de matemáticas**

**Resumen:** Este estudio cuantitativo fue diseñado para investigar la preparación docente como un sistema interactivo y, como parte de eso, examinar si enfoques individuales de preparación tienen beneficios diferenciales de retención entre diferentes subgrupos de docentes. Basado en datos longitudinales sobre profesores de matemáticas que ingresaron a la docencia a través del programa New York City Teaching Fellows (NYCTF), el estudio se centró específicamente en la retención en la primera escuela de dos subgrupos de docentes relevantes para la política, a saber, (1) los graduados de universidades muy selectivas y (2) miembros de la comunidad negra y latina. Mientras que todos los últimos asistían a las escuelas preparatorias de la ciudad, los primeros generalmente no lo hacían. En parte porque el campo carece de una teoría bien fundamentada de la relación entre la preparación inicial de los docentes y su retención, recurrimos a la teoría de la interseccionalidad e incorporamos efectos de interacción bidireccional en modelos cuantitativos de la retención de los maestros en la primera escuela. Encontramos relaciones significativas entre la capacitación inicial de NYCTF y la retención de maestros y, además, que la capacitación de NYCTF parecía otorgar diferentes beneficios de retención a diferentes subgrupos de maestros. También encontramos que los miembros de la comunidad negra y latina exhibieron tasas significativamente más altas de retención en la primera escuela que los graduados universitarios de élite y, en realidad, otros profesores de matemáticas de NYCTF. Los resultados tienen implicaciones claras para el reclutamiento y la formación de docentes y, en particular, la promesa de desarrollar profesores de matemáticas basados en la comunidad que se parezcan a los estudiantes a los que enseñan.

**Palabras clave:** retención docente; reclutamiento de maestros; maestros de las minorías; maestros comunitarios; análisis cuantitativo interseccional

### **Retenção escolar precoce de membros da comunidade negros e latinos e graduados de elite: Implicações para o recrutamento, seleção e treinamento de professores de matemática urbana**

**Resumo:** Este estudo quantitativo foi projetado para investigar a preparação de professores como um sistema interativo e, como parte disso, examinar se as abordagens individuais de preparação têm benefícios diferenciais de retenção entre diferentes subgrupos de professores. Com base em dados longitudinais sobre professores de matemática que ingressaram no ensino por meio do programa New York City Teaching Fellows (NYCTF), o estudo concentrou-se especificamente na retenção na primeira escola de dois subgrupos de professores relevantes para as políticas, a saber, (1) graduados

universitários altamente seletivos, e (2) membros da comunidade negra e latina. Enquanto todos estes frequentavam as escolas preparatórias da cidade, os primeiros geralmente não. Em parte porque o campo carece de uma teoria bem fundamentada da relação entre a preparação inicial e a retenção de professores, nos baseamos na teoria da interseccionalidade e incorporamos efeitos de interação bidirecional em modelos quantitativos de retenção de professores na primeira escola. Encontramos relações significativas entre o treinamento inicial do NYCTF e a retenção de professores e, além disso, o treinamento do NYCTF pareceu conferir diferentes benefícios de retenção a diferentes subgrupos de professores. Também descobrimos que os membros da comunidade negra e latina exibiam taxas significativamente mais altas de retenção na primeira escola do que os graduados de faculdades de elite e, de fato, outros professores de matemática da NYCTF. Os resultados têm implicações claras para o recrutamento e treinamento de professores e, em particular, a promessa de desenvolver professores de matemática baseados na comunidade que sejam como os alunos que eles ensinam.

**Palavras-chave:** retenção de professores; recrutamento de professores; professores de minorias; professores comunitários; análise quantitativa interseccional

### **The First-School Retention of Black and Latinx Community-Insiders and Elite College Graduates: Implications for the Recruitment, Selection, and Training of Urban Mathematics Teachers**

Teacher turnover has increased in recent years in the US (Sutcher et al., 2016). Early evidence indicates that it is accelerating in the wake of the COVID-19 pandemic and the accompanying Great Resignation, exacerbating teacher shortages in many public schools (Steiner & Woo, 2021; Streeter, 2021). In the U.S. context, turnover has been particularly acute among early-career teachers, alternatively-certified teachers, teachers of core subjects like mathematics, and teachers in schools serving low-income communities of color (Carver-Thomas & Darling-Hammond, 2017; Redding & Smith, 2016; Sutcher et al., 2016). Teacher turnover requires the investment of limited resources to search for replacements, can limit student growth (Ronfeldt et al., 2013), and can worsen the organizational functioning of schools (Sorensen & Ladd, 2020).

Debates about how to improve teacher retention, particularly in schools that serve low-income Black and Latinx communities, raise questions about who should be recruited to teach and how they should be prepared. Specifically, reformers who support market-based interventions in teacher education argue for “fast-track,” alternative pathways that attract the graduates of very selective colleges under the assumption that, as high achieving students they are particularly poised to raise student achievement while also helping to stabilize the teaching staffs of hard-to-staff schools (Brantlinger et al., 2020; Kopp & Morrison, 2019; Walsh & Jacobs, 2007). In contrast, many scholars of color argue for the recruitment and development of community-based teachers, particularly those who are Black and Latinx (Carver-Thomas & Darling-Hammond, 2017; Gist et al., 2019; Martin, 2007). The assumption is that, given their local ties and commitments, community-based teachers will stay for the long-term, and that this, coupled with their apparent strengths (e.g., cultural and racial competence), promises to improve the organizational culture and student outcomes of schools that serve low-income communities of color.

However, despite significant progress over the past several decades, the field has not advanced to the point where one can reasonably predict the kinds of new teachers that are likely to stay in local schools (Nguyen et al., 2020). We also understand little about what should be included in initial training to optimize the prospects of early-career teachers being retained for the long term.

To advance the field, scholars have called for research that examines how particular teacher subgroups working in specific school contexts interact with individual approaches or features of teacher preparation (Donaldson & Johnson, 2010; Humphrey & Wechsler, 2007). In particular, 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” (p. 5) and called 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” (p. 39).

This quantitative study responds to these calls by investigating how the first-school retention of different mathematics teacher subgroups is related to their initial training in a nationally prominent alternative certification program. This study especially examines the retention of two policy-relevant subgroups: *the graduates of very selective colleges* and *Black and Latinx community-insiders*, prospective teachers who graduated from an NYC high school and resemble the majority Black and Latinx students they teach in low-income NYC public schools. The study contributes to policy discussions about who should be recruited and how they should be prepared to teach Black and Latinx students in neighborhood urban schools (Brantlinger, 2020; Gist et al., 2019; Kopp & Morrison, 2019; Martin, 2007).

## Background and Framework

This literature review summarizes current knowledge about the relationship between teacher retention and teacher selection, initial preparation, and school assignments. Focusing on the U.S. literature, it contextualizes the current study of alternatively-certified mathematics teachers’ retention in their first schools. It also provides a rationale for the study variables and the investigation of interaction effects in the quantitative models of retention.

### Improving Teacher Retention Through Recruitment and Preparation

There are several proposed solutions to reduce teacher turnover in low-income neighborhood schools, including innovations in teacher recruitment. Some activists and scholars (e.g., Gist et al., 2019) propose to recruit community-based teacher candidates, particularly those who are Black and Latinx, under the assumption that possessing ties to local communities makes a teacher more committed to staying in local schools. Carver-Thomas and Darling-Hammond (2017), for example, recommend this strategy, noting that, “teacher preparation models [that] recruit community-based teachers... capitalize on the fact that teachers are more likely to stay and continue teaching in their own communities” (p. 33). Alternatively, many large urban schools have instead invested in selective alternative route programs like the New York City Teaching Fellows (NYCTF), other Teaching Fellows programs, and Teach For America, which recruit nationally from the nation’s most selective colleges and thus import high-achieving community outsiders to teach in lower-income district schools (Brantlinger, 2020).

Others advocate for improvements and innovations in initial teacher preparation as a way to improve early-career teacher retention. For their part, university-based teacher educators posit that, to improve early-career retention, new teachers should receive initial preparation that deepens their subject-matter and pedagogical content knowledge while also positioning them to be lifelong learners (e.g., Hammerness et al., 2005). This means that prospective teachers should invest considerable time, not only learning subject-specific teaching methods, but in learning foundational knowledge about adolescent development and multicultural education. On the other side of this argument, critics of traditional teacher education (e.g., Walsh & Jacobs, 2007) promote scaling back initial teacher preparation, particularly by eliminating “theoretical” or “ideological” certification

coursework, as a way to attract talented prospective teachers who otherwise would not consider teaching. They argue that new teacher training should be limited to the development of a basic repertoire of technical skills and professional dispositions so that these new teachers can hit the ground running. For example, current New York City Department of Education (NYCDOE) regulations stress that alternative route “[t]raining should address basic skills in instructional design and delivery and classroom management” (NYCDOE, 2006, p. 6).

### **Teacher Recruitment and Retention**

Teacher certification programs use a combination of recruitment and preparation strategies to supply schools with qualified new teachers (Van Overschelde & Wiggins, 2020). In crafting teacher recruitment and admission decisions, program staff implicitly acknowledge the impact of teachers’ backgrounds on program-level outcomes as they vet prospective teachers’ academic qualifications, race, ethnicity, and prior experience. NYCTF and other selective programs screen for an applicant’s academic ability using information about their grades, test scores, and college selectivity. However, evidence indicates that the high-achieving graduates of very selective undergraduate institutions leave teaching at higher rates than those from less selective colleges (Boyd et al., 2005; Kelly & Northrup, 2015). Typically sought as part of national, rather than local, recruitment campaigns, elite college graduates tend to have weak ties to local schools which may facilitate their exit (Boyd et al., 2005; Brantlinger, 2020).

Alternatively, community-based and grow-your-own programs actively seek *community-insiders* (i.e., teachers who are rooted in or have social ties to the local communities served by the schools), assuming that their ties and commitments to these particular communities will facilitate their retention in schools that serve them (Carver-Thomas & Darling-Hammond, 2017; Gist et al., 2019). Although there is some anecdotal evidence in support of this, to our knowledge no quantitative studies have examined whether *community-insiders* have greater school retention than *community-outsiders* and, in particular, outsiders from very selective colleges. In sum, the kind of teachers that teacher preparation programs recruit has implications for program-level outcomes such as retention.

### **Teacher Preparation and Retention**

Teacher educators and educational researchers generally assume that in-depth teacher preparation, including upwards of a full year in a clinical setting, will improve new teacher classroom success, commitment, and retention. In support of this, a few studies show that the amount of initial preparation that new teachers complete prior to entry is positively associated with their length of stay in teaching, although not necessarily in their original schools (Carver-Thomas & Darling-Hammond, 2017; Redding & Smith, 2016). Ingersoll, Merrill, and May (2014) find a positive association between the amount of mathematics teaching methods coursework that mathematics teachers complete during initial preparation and their retention. Consistent with this, several studies show that teachers trained in fast-track alternative certification programs, which omit, limit, or delay the features of traditional preparation (e.g., methods courses, practice teaching), leave low-income, high-minority (i.e., racially- and economically-segregated) schools, and the teaching profession, at higher rates than those from traditional certification programs (Carver-Thomas & Darling-Hammond, 2017; Redding & Smith, 2016). However, as Ingersoll et al. (2014) observe, research that examines the link between teacher retention and specific components of initial preparation is limited to a few studies.

## School Context and Retention

Numerous studies have examined how school contexts might affect the career decisions and retention of early-career teachers (e.g., Donaldson & Johnson, 2010; Hurst & Brantlinger, 2022). A consistent finding is that teacher turnover generally, and that of early-career teachers in particular, is comparatively high in schools that serve predominantly low-income and student-of-color populations. One possible explanation for this finding is that early-career teachers, and in particular those who are White teachers, leave “high-turnover” schools due to their dissatisfaction with teaching students of color or students from low-income families (e.g., Guarino et al., 2011). However, novice teachers may actually depart in response to the dysfunctional contexts (e.g., hostile work environments) of schools that often serve such students (e.g., Grant & Brantlinger, 2022a; Simon & Johnson, 2015). If new teachers feel like their school environment is conducive to their professional efforts, and specifically helping them to feel successful, they are more likely to stay (Johnson & Birkeland, 2003).

## Interactions Between Teacher Recruitment, Training, and School Contexts

In most quantitative analyses of teacher retention, the models are restricted to main effects. However, given that early-career teachers from different backgrounds might interact differently with the features of teacher preparation and contexts of the schools in which they work, the investigation of interaction effects seems warranted (Guarino et al., 2011; 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 and between components of teacher preparation (e.g., fieldwork and methods courses). An alternative approach is to disaggregate the analysis, running parallel analyses for different teacher subgroups (e.g., Black and White teachers; see, for example, Ingersoll et al., 2019).

Three retention studies have researched interactions between teacher and student race. Specifically, Scafidi et al. (2007) find that, in Georgia, Black elementary teachers are 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. Also looking at North Carolina teachers, Guarino and colleagues (2011) model multiple interactions between student demographics and teacher background. They find that schools that serve high proportions of non-White and low-income students attract lower percentages of new teachers with desirable qualifications and also lose their teachers with desirable qualifications to other state schools.

Two studies have investigated how interactions between features of initial preparation shape teachers’ actual or intended retention. Ingersoll and colleagues (2014) consider how interactions between teacher preparation and teachers’ subject matter assignments (i.e., mathematics, science, other) moderated the effects of preparation on teacher retention in their current school. In an endnote, they report that very few interaction effects were statistically significant and, as such, did not discuss any in the main text of their report. However, based on the lack of significant interactions, they conclude that the odds of the attrition of mathematics (and science) teachers who enter with an education degree is not different than the odds of attrition of those who enter with a non-education degree. Ronfeldt et al. (2014) examine how interactions between teaching methods courses and student teaching influence pre-service teachers’ plans to stay in teaching. They find 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” (pp. 3-4). The evidence accumulating across these studies suggests that the interactions among different components of teacher preparation and teacher retention may depend on the program, the types of teachers it attracts, and the schools in which they teach.

## Theoretical Perspective

Theoretically, we are interested in examining the extent to which the retention of different teacher subgroups is differentially associated with specific approaches to teacher training. Following others who examine the outcomes of teacher preparation (Donaldson & Johnson, 2010; Humphrey & Wechsler, 2007; Ronfeldt et al., 2014), we posit that teacher retention results from how different teacher subgroups working in particular school contexts respond to certain features of teacher preparation programs (e.g., teaching methods courses, practicum seminars). The underlying assumption is that teachers experience preparation programs and developmental opportunities differently based on their social identities, prior lived experiences, and current teaching contexts (Humphrey & Wechsler, 2007; Johnson & Birkeland, 2003; Nguyen et al., 2020).

This assumption is consistent with theories of intersectionality that posit that people—and their experiences, opportunities, decision-making, and life circumstances—are subject to intersecting power relations based on their status in racial, class, and other social hierarchies (Collins, 2019). Given its qualitative focus on people’s lived experiences, intersectionality theory has not typically informed quantitative research. However, recently researchers have begun to explore the implications of intersectionality theory for critical quantitative research (Covarrubias & Vélez, 2013; Frank et al., 2021; Khalil & Brown, 2020). Although researchers debate what such analyses should look like, a quantitative intersectional analysis examines whether or how much one category (e.g., race) behaves differently relative to an individual’s status in another category (or categories; e.g., gender, social class). That is, an intersectional quantitative approach allows researchers to investigate not only main or additive effects, but also interaction or multiplicative effects involving these categories. The approach encourages quantitative researchers to move beyond examining how a category like race operates in isolation from other demographic categories, to a potentially more nuanced analysis that views these categories as operating interactively.

## Research Questions

This study addresses the following research questions about the retention of elite college graduates, referred to as *Elites*, and Black and Latinx community-insiders, referred to as *Black-Latinx Insiders*, who became mathematics teachers through NYCTF in either summer 2006 or 2007.

- How does the first-school retention of different mathematics teacher subgroups, and in particular *Elites* and *Black-Latinx Insiders*, compare at one-, three-, and five-years?
- How does the retention of the teacher subgroups, and in particular *Elites* and *Black-Latinx Insiders*, vary with respect to differences in approaches to initial training?
- How does the retention of the teacher subgroups, and in particular *Elites* and *Black-Latinx Insiders*, vary with respect to student demographics and rates of attendance of their first schools?

To clarify, the first question addresses policy debates about who should be recruited to teach in schools that serve low-income, majority Black and Latinx student populations.<sup>2</sup> The second addresses the field’s interest in examining the elements of teacher preparation programs in relationship to each other as an interactive system (Humphrey & Wechsler, 2007; Ronfeldt et al.,

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<sup>2</sup> Native American students were not a focus because their proportion in all of the sampled schools was below 1%.

2014). The third addresses the field's interest in how the match between teacher and student characteristics, and particularly race/ethnicity, influences the teachers' first-school retention.

## Methods

To answer the research questions, we modelled the first-school retention of *Elites*, *Black-Latinx Insiders* and two other NYCTF mathematics teacher subgroups. The models included variables for initial training the teachers received and the contexts of their first schools. Whereas the subgroup categories were chosen based on policy debates about who should be recruited to teach in low-income, high-poverty schools, the school-level variables were chosen theoretically, based on the retention literature. The training variables were chosen based on prior project research on NYCTF and its mathematics teachers (Brantlinger et al., 2010; Cooley et al., 2019; Meagher & Brantlinger, 2011). And, due to our theoretical interest in examining teacher preparation as an interactive system, we included two-way interaction terms in the retention models.

### Study Context and Participants

Launched in 2000, NYCTF was the flagship Teaching Fellows program. At that time, district leaders expressed grave concerns about teacher quality, particularly the large numbers of uncertified teachers in most NYC public schools (Brantlinger, 2020). Influenced by Teach For America, NYCTF was designed in part to replace uncertified teachers with alternatively-certified teachers who generally had better academic credentials (i.e., higher exam scores, transcripts and recommendations from very selective colleges). An assumption was that this elite teacher corps would produce higher achievement amongst their students than both uncertified teachers and veteran certified teachers in low-income, high-minority schools. A second assumption was that NYCTF would help the district address perennial staffing needs in these schools. As part of this, NYCTF required its teachers to sign a two-year commitment to the district in exchange for a heavily subsidized master's certification program in secondary mathematics at one of four university partners (Brantlinger & Smith, 2013). In theory, but not always in reality, teachers who left before completing the two-year commitment were required to pay back a portion of the master's program costs.

Our research sample included 617 NYCTF mathematics teachers who began paid teaching in NYC public schools in either the 2006–2007 or the 2007–2008 school year. This was more than 95% of the secondary mathematics teachers from these two cohorts. These NYCTF mathematics teachers comprised more than 65% of all new secondary mathematics teachers entering the district in these two schoolyears (Boyd et al., 2012; Brantlinger & Smith, 2013). They became teachers of record after completing NYCTF's initial training which included 120 to 160 hours of master's certification coursework, a minimum of 40 hours of practice teaching in a summer school classroom, and 40 hours of NYCTF-delivered training.

### NYCTF Training for Secondary Mathematics and the Teachers' First Schools

The current study examines within-program differences, specifically examining the training of secondary mathematics teachers in NYCTF. Specifically, in the mid-2000s, NYCTF contracted with four local universities for the provision of master's certification coursework in secondary mathematics. The teachers' university assignments were based on their place of residence in relation to the four campuses; that is, the teachers did not select which university they attended.<sup>3</sup> Each

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<sup>3</sup> In terms of the subgroups (see methods section), *Non-Elite Outsiders* were spread very evenly across the universities and advisories. In comparison, *Black-Latinx Insiders* and *White-Asian Insiders* both were somewhat more likely to receive *Technical Training* whereas *Elites* somewhat less likely to do so. Members of the teacher



university's coursework emphasized different ideas and traditions (Boyd et al., 2012; Brantlinger & Smith, 2013). Two provided *mathematics-specific training*, prioritizing mathematics teaching methods and mathematics content courses. The third university provided *technical training*, concentrating on techniques for classroom organization and management while limiting ostensibly theoretical or political topics and also coverage of mathematics-specific topics. Training at the fourth university stressed *developmental theories* (e.g., child psychology, adolescent development) and other foundations topics, including multicultural education. Thus, in modelling the teachers' retention, we distinguish between *mathematics-specific*, *technical*, and *developmental training* emphases.

Fieldwork Advisory is the second component of NYCTF training that we included in models of the teachers' first-school retention. It served as a practicum forum for teachers to reflect on their experiences with practice teaching in summer school classrooms. NYCTF teachers also read and discussed chapters from The New Teacher Project's (2005) *Teaching for Student Achievement Guidebook* in Fieldwork Advisories. The Guidebook covered supposedly "proven" techniques for raising student achievement and implementing classroom routines and management. Training in Advisories was subject-general and technical and, in this sense, was highly consistent with technical training but generally inconsistent with developmental and mathematics-specific training (Brantlinger & Smith, 2013). While held on the partnering campuses, Fieldwork Advisory was organized and staffed by NYCTF rather than the universities. There were approximately 20 teachers in each Advisory group and 31 total Advisory groups across the two cohorts. Teacher assignment to the Advisory groups appeared to be random.

After completing the summer pre-service program, the mathematics teachers began paid teaching in either a public middle or high school while continuing to take master's certification coursework at their assigned university. NYCTF teachers were restricted to finding positions in "high needs" neighborhood schools in different regions throughout the city based on their place of residency. Most of the teachers (>75%) found their school positions through interviews with school administrators at regional job fairs while others (<20%) were placed by NYCTF in consultation with the district (Brantlinger, 2021). Most of the students in these schools were from low-income backgrounds; on average, 78.4% received subsidized (i.e., free or reduced-price) lunch. The students in these schools also were predominantly Latinx and Black; specifically, NYC public schools counted 37.6% as Black and 48.5% as Latinx, with many Latinx students of Afro-Latinx descent. Specifically, Puerto Rican and Dominican students comprised the majority of Latinx students, followed by Colombians, Mexicans, Ecuadorians, and Salvadorans. Those categorized as Black included African Americans and also immigrants or descendants of immigrants from Jamaica, other Caribbean nations, and sub-Saharan Africa.

## Study Data

This study draws on teacher service history, student demographic, project survey, and district survey data from the aforementioned 617 teachers. Provided by the NYCDOE, the *service history data* covered the period from 2006 to 2016. The datafile included school assignment, roles, and retention information for 97% of the 617 study teachers. It also provided information on their start and stop dates in individual district schools and basic demographic data including teacher race. Additional *background information* (e.g., undergraduate institution, college major, high school location) was provided by project surveys conducted at three points in time, namely: (1) at the end of the teachers' pre-service summer training in either 2006 or 2007, (2) at the end of their first year in

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subgroups were essentially evenly distributed to schools based on student attendance and subsidized lunch. However, *White-Asian Insiders* started in schools with somewhat lower proportions of Black and Latinx students (by about 10% on average) than the other subgroup members.

either 2007 or 2008, and (3) in 2016, nine or 10 years after the teachers had entered teaching. Most (96.5%) of the teachers completed at least one of the project surveys. The *student demographic data* came from the New York State Education Department. This data included school-level information on student race, free and reduced lunch status, and daily rates of student attendances for individual school-years.

## Teacher Subgroups and Measures

### *Teacher Subgroups*

We used the study data to sort the NYCTF mathematics teachers into four subgroups. We specifically categorized about a third of the teachers as *Elites*; namely, those who graduated from the 85 undergraduate institutions (of the 250 total) that were ranked as most selective on Barron's 2007 undergraduate institution rankings (College Division of Barron's Education, 2007).<sup>4</sup> We next used information on the teachers' high school locations to categorize the remaining sample teachers as either *community-insiders* or *community-outsiders*. However, due to theoretical and policy-related interests in teacher race, we divided the *community-insiders* into two subgroups, namely, *Black-Latinx Insiders* and *White-Asian Insiders*. The remaining teachers were *Non-Elite Outsiders*; that is, those teachers who neither graduated from a very selective college nor a NYC high school. *Non-Elite Outsiders* were the largest subgroup and, not being a focus of teacher recruitment initiatives, served as the study's comparison group.

### *Retention Measures*

The service history data was used to create dichotomous variables for retention in the teachers' first NYC public schools at the one-, three-, and five-year marks. We modelled retention at different points in time as the retention literature suggests that teachers leave and stay in teaching for different reasons as they gain experience. One and five years are common referents in the retention literature, with five years serving as a common referent for "mastery." Three years captures teachers who stayed beyond NYCTF's required two-year commitment. Naturally occurring breaks in the service history data allowed us to choose cut points of 0.9, 2.9 and 4.9 years in creating the dichotomous retention variables that distinguished teachers who left prior to completing one, three, and five full years from those who effectively stayed for at least one-, three-, and five-full years. The study measures referred to retention in any paid role in the district, although all of the sampled teachers began as secondary mathematics teachers, and within their first five years very few had transitioned into other roles.

### *Training Measures*

NYCTF provided information on the teachers' assignments to the different partner universities and Fieldwork Advisories. We included a categorical variable for university training that distinguished between *Mathematics-Specific*, *Developmental*, and *Technical Training*. Based on qualitative research conducted on NYCTF mathematics teachers between 2006 and 2008 (e.g., Meagher & Brantlinger, 2011), we understood that, in addition to university coursework, many of the teachers saw NYCTF's Fieldwork Advisories as particularly important to their development and their sense of purpose as urban mathematics teachers. On the first survey, 435 of the 617 teachers provided evaluative quality data on their Advisory groups (there were 31 groups in total) by rating the extent to which these helped them, "to understand [their] clinical fieldwork experiences," "to learn about

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<sup>4</sup> As college selectivity is arguably the principle criterion used by selective alternative route programs to recruit teachers, selectivity of the teachers' undergraduate institution was prioritized over high school location in this study.

teaching methods” and “to learn classroom management” – three focal areas of Advisory sessions. A gap in the aggregated ratings was used to distinguish between *Effective* (i.e., higher-rated) and *Ineffective* (i.e., lower-rated) *Advisories*; on average, teachers from the eight *Effective Advisories* agreed or strongly agreed that their section addressed the three focal areas whereas, in the aggregate, those from the 23 *Ineffective Advisories* “neither agreed nor disagreed” with these statements.<sup>5</sup>

### **School Context Measures**

Drawing on state data, we included four continuous, mean-centered measures of student characteristics, namely: (1) daily student attendance rates, (2) proportions of students on subsidized (i.e., free or reduced-price) lunch, (3) percentage of Latinx students, and (4) percentage of (non-Latinx) Black students. We used data from either 2006–2007 or 2007–2008 depending on individual teachers’ year of entry.

### **Data Analysis**

Because the field lacks a mature and substantiated theory of the interactive relationship between teacher preparation and teacher retention, this quantitative analysis was exploratory. In particular, we used a step-wise analysis to build, rather than test, retention models that included significant two-way interaction effects between the teacher subgroups and the measures of training and school context. We selected logistic regression modelling as retention at the end of a certain interval of time is a binary outcome. We used this cross-sectional approach as it produces intuitive results for easy interpretation. Using STATA (command *stepwise*), we estimated the coefficients of the models predicting the odds of individual teachers remaining in their first schools at one, three, and five years. These models were estimated as:

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

The coefficients  $\beta_i$  represent the expected change in the retention outcome (in log-odds units) for an individual teacher provided vectors for their subgroup membership ( $X_1$ ), NYCTF training ( $X_2$ ), and first-school contexts ( $X_3$ ). The model also includes one vector for pairwise interactions between teacher subgroups and training ( $X_1 X_2$ ) and one for teachers and school contexts ( $X_1 X_3$ ). As almost half of the teachers (45%) began teaching in a school with at least one other first-year NYCTF teacher, we calculated the intraclass correlations (ICC) which were .221, .386 and .427 respectively for the five-, three-, and one-year outcomes. As these were sufficiently large, we accounted for the clustering of teachers in first schools by using cluster-robust standard errors.

The model building process for each retention outcome occurred in two steps. First, all of the main effects were entered and specified for inclusion in the final model. Second, as thirty interaction terms would not be viable to include together in the retention models, particularly with the sparseness that would result with a categorical outcome, we used a stepwise procedure (Bursac et al., 2008; Zhang, 2016) to select interaction effects for inclusion. All thirty interaction effects were entered in the second block and tested for inclusion or exclusion in the models using a forward procedure. The probability of stepwise entry and the probability of stepwise removal were both set at the 0.10-level using the Wald test of significance. Missing data was eliminated listwise in the analysis; the models included 97% (or 598) of the 617 observations, with missing data appearing to be random. To clarify further, we chose to use a stepwise procedure because the approach is designed to maximize the model fit while minimizing the potential impact of multicollinearity,

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<sup>5</sup> Response rates varied from 63-91% depending on the Advisory section. Missing data might have resulted in the mis-identification of one or two sections.

incorporating information beyond the statistical significance of particular variables (Bursac et al., 2008).

The final step was to interpret the finalized retention models which included multiple interaction effects. As part of this, we estimated outcomes under the *typical conditions* of training and first schools. For our models, typical conditions meant estimating the retention outcomes for a teacher who, like the majority of NYCTF mathematics teachers, was assigned to mathematics-specific training, a lower-rated Fieldwork Advisory group, and a typical first school where the four student-level variables were at the mean.

## Results

### Descriptive Statistics

Table 1 provides descriptive statistics for the four teacher subgroups. It specifically shows that a third (33%) of the NYCTF mathematics teachers were *Elites*, recruited from the nation's most selective colleges. The vast majority of *Elites* also graduated from a high school located outside of NYC and, in this sense, were community-outsiders. Although majority White (55%), *Elites* were fairly diverse with the remainder identifying as 21% Asian, 18% Black, and 6% Latinx. Just over half (51%) were female. They were the youngest subgroup on average, entering with a median age of 24 years. NYCTF considered 70% of *Elites* to be recent college graduates as they had entered teaching within three years of finishing their undergraduate degrees (a marker set by federal guidelines). It counted the remaining 30% as career changers.

**Table 1**

*Descriptive Statistics for the Mathematics Teacher Subgroups*

		Elite	Black-Latinx Insider	White-Asian Insider	Non-Elite Outsider
		<i>n</i> = 205	83	54	273
College	Very Selective (%)	100	0	0	0
	Other (%)	0	100	100	100
High School	In NYC (%)	16	100	100	0
	Outside of NYC (%)	84	0	0	100
	Public (%)	74	79	66	84
Race/ Ethnicity	White (%)	55	0	69	66
	Asian (%)	21	0	31	14
	Black (%)	18	66	0	14
	Latinx (%)	6	34	0	6
Gender	Female (%)	51	60	57	48
Entry Age	Mean (Years)	28	30	32	29
	Median (Years)	24	26	26	25
Entry Status	Career Changers (%)	30	44	49	33

*Black-Latinx Insiders* comprised 13% of the NYCTF mathematics teacher population. Two-thirds were Black and one-third were Latinx.<sup>6</sup> About 60% were female. Collectively, *Black-Latinx Insiders* were a little older than *Elites*, having entered teaching at a median age of 26 years. Consistent

<sup>6</sup> A small number of Latinx teachers self-identified as Black or mixed race on surveys.

with this, a sizable proportion (44%) were career changers. *White-Asian Insiders* comprised 9% of the NYCTF mathematics teacher population. They were majority (69%) White and minority (31%) Asian. As with *Black-Latinx Insiders*, *White-Asian Insiders* skewed female (57%). *White-Asian Insiders* were the oldest subgroup and, reflective of this, almost half (49%) were career changers. The fourth and largest subgroup were the *Non-Elite Outsiders* who, by definition, were neither graduates of NYC high schools nor of very selective colleges. They were majority (66%) White and were the only subgroup that was majority (52%) male. Their median age was 25 years, making them the second youngest subgroup after *Elites*. Accordingly, two-thirds were recent college graduates and only one third were career changers.

**Table 2**

*Descriptive Statistics for Study Variables and Corresponding Rates of First-School Retention*

		%	School Retention (%)		
			Year 1	Year 3	Year 5
	Combined Sample	100	85	52	31
Teacher Subgroups	Elite (Very Selective College Graduate)	33	81	44	22
	Black-Latinx Insider	13	92	61	43
	White-Asian Insider	9	93	59	39
	Non-Elite Outsider	44	84	54	33
Teacher Characteristics	Less Selective College Graduate	66	87	56	35
	NYC High School Graduate (Insider)	28	92	58	39
	Other High School Graduate (Outsider)	72	82	51	28
	Latinx	9	91	52	26
	Asian (non-Latinx)	16	84	51	22
	Black (non-Latinx)	21	90	64	44
	White (non-Latinx)	54	82	49	30
Training	Mathematics-Specific Training	63	86	53	31
	Technical Training	19	89	58	42
	Developmental Training	19	79	44	21
	Effective Advisory	26	93	60	41
	Ineffective Advisory	74	82	50	28
Student Characteristics	Black (14% to 62%)	64	83	50	28
	Black (> 62%)	14	87	50	33
	Latinx (26% to 72%)	64	85	51	30
	Latinx (> 72%)	11	85	56	27
	Subsidized Lunch (62% to 94%)	75	88	53	35
	Subsidized Lunch (> 94%)	16	71	45	23
	Attendance (81% to 94%)	73	86	55	33
	Attendance (> 94%)	18	73	53	35

*Note:*  $n = 615$ .

Table 2 provides descriptive information about the relationship between the teachers' first-school retention and the study variables. Without controlling for the effects of training and schools, Table 2 shows that *Black-Latinx Insiders* and *White-Asian Insiders* exhibited comparatively high rates of school retention, *Elites* exhibited comparatively low rates, and the rates of *Non-Elite Outsiders* were in between. Looking at the rows for teacher race/ethnicity, Black teachers exhibited higher overall rates of first-school retention than did the White, Asian, and Latinx teachers.

Table 2 also shows that the different approaches to university training were associated with different rates of first-school retention: *Developmental Training* with the lowest retention and *Technical Training* with the highest. Further, teachers assigned to *Effective (Fieldwork) Advisories* exhibited significantly higher retention rates than those assigned to *Ineffective Advisories*. These descriptive relationships between training and retention may have been an artifact of the non-random assignment of the teachers to universities, Fieldwork Advisories, and particular geographical regions. As previously indicated, the teachers were assigned to one of the universities based on where they resided in NYC and were restricted to working in schools in those regions closest to their assigned university campus, in part to ensure reasonable travel times.

Table 2 also provides descriptive information about the relationship between the teachers' retention in their first schools and the characteristics of students in those schools. Some of these relationships were straightforward, others less so. On the straightforward side, the teachers left schools with high proportions of students on subsidized lunch at a higher rate than they left those with lower proportions. The descriptive relationships between student race/ethnicity and retention were less straightforward; in particular, the teachers tended to stay in schools with high proportions Black students but tended to leave those with high proportions of Latinx students. The latter relationship but not the former is consistent with the literature. Finally, the descriptive relationship between students' daily rates of attendance and first-school retention was complex and not consistent with the positive relationship documented in the literature. In particular, a year after entry, a higher proportion of teachers were retained in schools with typical rates of daily student attendance (i.e., a standard deviation within the mean rate of 87%) than in schools with high rates (i.e., rates a standard deviation above the mean – above 94%). However, five years after entry, the reverse relationship held.<sup>7</sup>

### The First-School Retention of the Different Teacher Subgroups

This section addresses our first research question by examining the results of our retention models (Table 3) focusing on the teacher subgroups. At the broadest level, these models show that members of different teacher subgroups, and *Black-Latinx Insiders* and *Elites* in particular, exhibited markedly different rates of first-school retention. Additionally, their retention varied significantly through their interactions with NYCTF's initial training and the characteristics of students in their first schools. The models also show, to some extent, that the main drivers of early-career teachers' retention varied across these three points in time.

First, the models show that the odds of *Black-Latinx Insiders* being retained in their first schools were generally much higher than those of *Elites* (Table 3). Specifically, the Year 3 model estimates that, under typical conditions of training and student characteristics in schools, the odds of *Elites* remaining was 43.1% lower than the odds of *Non-Elite Outsiders* remaining ( $p < .01$ ). In contrast, the estimated odds of *Black-Latinx Insiders* remaining were 39.4% higher than those of *Non-Elite Outsiders* (a non-significant difference). By extension, the Year 3 model estimated that, under typical conditions of training and first schools, the odds of *Black-Latinx Insiders* remaining at three years was 141.5% higher than those of *Elites* (Wald test, chi-squared = 2.91,  $p < 0.10$ ). Consistent with this, the Year 5 model estimates that, in comparison to *Non-Elite Outsiders*, the odds of *Black-Latinx Insiders* remaining were 125.6% higher ( $p < .05$ ) whereas the odds of *Elites* remaining were about 35.6% lower (a non-significant difference). Hence, by extension, the estimated odds of *Black-*

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<sup>7</sup> Schools with high attendance rates may have had an easier time finding replacements and, as such, their administrators would be able to dismiss first-year, untenured teachers at higher rates than administrators at schools with lower rates of student attendance.

*Latinx Insiders* remaining at five years were significantly greater than the estimated odds of *Elites* remaining; specifically, estimated to be about 250% greater (Wald test, chi-squared = 9.96,  $p < 0.01$ ).

Second, although the retention gap between *Black-Latinx Insiders* and *Elites* held under most of the modelled conditions of initial training and first schools, there were exceptions to this general pattern. The two significant interaction effects at the teacher-training level provide support for our claim that members of the different subgroups derived different retention benefits as a result of interacting differently with particular approaches to initial training. In particular, the *Elite\*Developmental Training* interaction in the Year 3 model indicates that *Elite* teachers seemed to benefit from *Developmental Training* in way that their counterparts did not. Specifically, *Elites* who received *Developmental Training* had similar odds of remaining at three years with those of *Black-Latinx Insiders* who received *Developmental Training*. Similarly, the *Black-Latinx Insider\*Technical Training* interaction in the Year 5 model indicates the *Black-Latinx Insiders* did not receive the same modest (and statistically non-significant) five-year retention benefit from *Technical Training* that members of the other subgroups received. Specifically, *Black-Latinx Insiders* and *Elites* who received *Technical Training* had similar odds of five-year retention in their first schools. (Note that we present specific estimates for these interaction effects in the next section.)

**Table 3**

*Logistic Regression Models of Teachers' First School Retention (Odds Ratios).*

		Year 1	Year 3	Year 5
Teacher	Elite	0.995	0.569*	0.644 <sup>Δ</sup>
	White-Asian Insider	2.290	1.133	1.008
	Black-Latinx Insider	1.993	1.394	2.256**
Training	Technical Training	0.861	0.876	1.354
	Developmental Training	0.639	0.481**	0.609 <sup>Δ</sup>
	Effective Advisory	6.637**	1.474*	1.697*
Teacher*Training	Black-Latinx Insider*Technical Training			0.320*
	Elite*Developmental Training		2.887*	
	Elite*Effective Advisory	0.168*		
Student	Black	0.990	0.990	0.986*
	Latinx	0.988	0.992	0.983*
	Subsidized Lunch	1.006	1.000	0.996
	Attendance	1.019	1.036*	1.047*
Teacher*Student	Elite*Subsidized Lunch			1.023 <sup>Δ</sup>
	Elite*Attendance	0.935*		
	White-Asian Insider*Subsidized Lunch	1.046*		
	White-Asian Insider*Attendance	1.153*		
Constant		4.641**	1.242	0.404**
Goodness of Fit	Pseudo-R <sup>2</sup>	0.097	0.079	0.103

Note:  $n = 615$  for each model.

\*\*  $p < 0.01$ , \*  $p < 0.05$ , <sup>Δ</sup>  $p < 0.10$

Standard error adjusted for 450 clusters based on teachers' first school assignments.

Third, the Table 3 models also indicate that the main drivers of the teachers' retention varied as the years progressed, i.e., as the teachers who remained gained experience. For example, the *Developmental Training* main effect was predictive in the Year 3 model but in neither the Year 1 nor Year 5 model, whereas *Technical Training* was only predictive in the Year 5 model through an

interaction with the *Black-Latinx Insider* subgroup. As a second example, three of the four student main effects were predictive in the Year 5 model whereas none were predictive in the Year 1 model.

### Initial Training and the First-School Retention of the Different Teacher Subgroups

This section addresses our second research question about the relationship between NYCTF training and first-school retention. Whereas the previous section analyzed the results in Table 3 through the lens of teacher subgroups, this section reviews them through the lens of initial teacher training. Building on the last section, this analysis specifically supports two main claims: (1) that certain features of or approaches to initial training was associated with similarly significant retention benefits to early-career teachers independent of their subgroup membership but also (2) that, through interactions, NYCTF's initial training provided significantly different retention benefits to teachers depending on their subgroup membership.

Supporting the first claim, NYCTF's Fieldwork Advisories exhibited a consistent relationship with retention at all three time points. *Effective Advisory* is the only training-level main effect that is significant in all three retention models and the effect sizes (i.e., the odds ratios) are sizable (Table 3). The Year 3 and Year 5 models specifically estimate that assignment to an *Effective Advisory*, relative to an *Ineffective Advisory*, corresponded with a 47.4% increase in the odds of a teacher remaining at three years and a 67.9% increase in their odds of remaining at five years, irrespective of their subgroup membership. The main coefficient for *Effective Advisory* is even larger in the Year 1 model than in the Year 3 and Year 5 models.

Supporting the second claim, the significant *Elite\*Effective Advisory* interaction in the Year 1 model clarifies that, for *Elites*, an *Effective Advisory* only provided a benefit of approximately 10% increased estimated odds of completing one full year of service in their first school—a much lower benefit compared to their non-elite peers. This differentiated Year 1 outcome supports the second main claim that certain features or approaches to initial training distributed different retention benefits to the teachers depending on their subgroup membership.

Two other significant effects at the teacher-training level provide additional support for this second claim. First, in the Year 3 model, the *Elite\*Developmental Training* interaction indicates that *Developmental Training* was associated with significantly higher odds of *Elites*—but not members of the other subgroups—being retained in their first schools at three years, compared to the other training approaches. Specifically, the Year 3 model estimates that receiving *Developmental Training* instead of the other types of training increased the odds of *Elites* remaining at three years by 38.8% while reducing the odds of their counterparts remaining at three years by 51.9%. Second, in the Year 5 model, the *Black-Latinx Insider\*Technical Training* interaction shows that the *Black-Latinx Insiders* did not receive the same modest (and statistically non-significant) five-year retention benefits from *Technical Training* that their counterparts received. Specifically, the Year 5 model estimates that, relative to other training types, *Technical Training* was associated with a 2.5% decrease in the odds of *Black-Latinx Insiders* remaining but a 35.4% increase in the odds of members of the other subgroups remaining in their first schools at five years.

### Student Characteristics and the First-School Retention of Different Teacher Subgroups

This section addresses our third research: how do teacher subgroups' first-school retention varied in accordance with the characteristics of the students in those schools? Looking at the student-level main effects (Table 3), *Black Students*, *Latinx Students* and *Attendance* were all significant in the Year 5 model, *Attendance* was significant in the Year 3 model, and no student-level main effects were significant in the Year 1 model. Given this, we start with the five-year outcomes and work backwards to the first-year outcomes.



The Year 5 model estimates that an increase in either the proportion of *Black Students* or the proportion of *Latinx Students* corresponded with the decreased odds of NYCTF mathematics teachers remaining in their first schools at five years ( $p < 0.05$ ). Additionally, increases in students' rates of daily school *Attendance* corresponded with significantly increased odds of the teachers remaining in their first schools at three and five years ( $p < 0.05$ ). The directionality of these results are consistent with results in the literature.

Although the Year 1 model included no significant student-level main effects, it did include three significant interaction effects between student-level variables and teacher subgroups (Table 3). These suggest that members of the different teacher subgroups interacted differently with, or reacted differently to, the students they taught in their first schools and this factored into their first-year retention outcomes. More specifically, the Year 1 model included two significant interactions involving student attendance, namely, *Elite\*Attendance* and *White-Asian Insider\*Attendance*. The directionality of these interactions were different: an increase in *Attendance* corresponded with decreased odds of *Elites* remaining but increased odds of *White-Asian Insiders* remaining in their first schools at the end of their first year. Further, although not significant, the *Attendance* main effect estimates that an increase in student attendance corresponded with modestly improved retention for members of the remaining two subgroups, namely, *Black-Latinx Insiders* and *Non-Elite Outsiders*. In sum, the positive relationship between student attendance and teachers' first year retention reported in the literature does not hold for *Elites* but does hold for their non-Elite counterparts.

The Year 1 model also includes the significant *White-Asian Insider\*Subsidized Lunch* interaction. This indicates that an increase in the proportion of students on subsidized lunch corresponded with significantly increased odds of *White-Asian Insiders* being retained in their first schools a year after entry. The Year 1 model estimates that a 10% increase in the proportion of students on *Subsidized Lunch* would result in a 67.0% increase in the odds of *White-Asian Insiders* remaining in their first school at the end of their first year but only a 6.7% increase in the odds of their counterparts remaining. (Although not significant, the *Subsidized Lunch* main effect was weakly positive.) These results, particularly that for *White-Asian Insiders*, run counter to the extant research which generally finds a negative relationship between subsidized lunch (or student poverty) and the retention of teachers. It may be that the teachers' commitment to teach in the NYC public school district (although not necessarily in their first school) a minimum of two-years kept them for a year or longer in schools they otherwise might have left. It may also be that principals in schools with lower proportions of students on subsidized lunch were better able to find replacements and, as such, found it easier to dismiss first year—and untenured—teachers they disfavored.

Unlike Sun (2018) and Scafidi et al. (2007), who found Black teachers to be more likely to stay in schools with high proportions of Black students, the Table 3 models did not show that Black-Latinx Insiders were more likely than other NYCTF mathematics teachers to stay in first schools with high proportions of either Black students or Latinx students. Due to a theoretical interest in how teachers' racial/ethnic match with their students might influence their retention, we conducted two post-hoc analyses to further probe the robustness of this particular result and to critically examine our operationalization of teachers' race-ethnicity. First, we split the *Black-Latinx Insider* subgroup into *Black Insiders* and *Latinx Insiders* before rerunning the stepwise regression analyses (with five subgroups). As with the main analysis, this post-hoc analysis did not find significant interactions between either *Black Insiders* with Black students or *Latinx Insiders* with Latinx students.

For the second post-hoc analysis, we used the four racial-ethnic categories of Latinx and (non-Latinx) Asian, Black, and White teachers instead of the four teacher subgroup categories used in the main analysis. Using this approach, only the revised Year 5 retention model included a positive interaction between Latinx teachers and the proportion of Latinx students. This model specifically estimated that increases in the percentage of Latinx students significantly increased the

estimated odds of Latinx teachers remaining in their first schools at five years whereas the opposite held for non-Latinx teachers. Although statistically significant ( $p < 0.01$ ), the effect size was small. Specifically, the five-year model estimated that a one standard deviation increase (approximately 24%) in the percentage Latinx students in the building corresponded with a 2% increase in the odds of Latinx teachers remaining and a 6% decrease in the odds of their non-Latinx counterparts remaining. Consistent with the first post hoc outcomes, the second post hoc analysis revealed that the parallel effect for Black teachers and Black students was not statistically significant in any of the post-hoc models of the teachers' district retention.

## Discussion

This quantitative study was designed to investigate teacher preparation as an interactive system and, as part of that, to understand the extent to which differential approaches to initial teacher training might differentially benefit different teacher subgroups. To accomplish this, it incorporated two-way interaction effects in logistic regression models of teachers' first-school retention. Significant interaction effects in these models provide evidence that individual training approaches can distribute significantly different retention benefits to members of different teacher subgroups.

### Significance for Research

At the broadest level, the study backs calls for quantitative research that conceptualizes teacher preparation as an interactive system (Donaldson & Johnson, 2010; Ronfeldt et al., 2014) and, as part of this, uses teacher subgroups as a unit of analysis (Humphrey & Wechsler, 2007). The assumption is that initial training that works well for certain types of teachers may not work as well for others. The modelled retention results (Table 3) provide support for this assumption. An implication is that the search for teacher preparation approaches or programs that prove to be effective for most, if not all, new teachers may be in vain.

Viewing teacher preparation as an interactive system is also consistent with intersectional research that posits that people's racial, social class, gender, and other identities interactively shape their lived experiences, opportunities, and life outcomes (Collins, 2019). Our construction of the four teacher subgroups, including *Elites* and *Black-Latinx Insiders*, was inspired by intersectionality research and, in particular, critical intersectional quantitative research and related QuantCrit research (e.g., Frank et al., 2021; Khalil & Brown, 2020). The regression result (Table 3) that *Black-Latinx Insiders* exhibit comparatively high rates of first-school retention, in this sample of schools that mostly serve lower-income Black and Latinx students, is an intersectional result that challenges the frequently cited non-intersectional result that, in the US, Black teachers have higher rates of attrition than White teachers (e.g., Carver-Thomas & Darling-Hammond, 2017). It may be that the field's reliance on broad racial and other categories has led to overly-broad generalizations about the relationship between teachers' characteristics like race and their retention. Thus, intersectional and interactional quantitative analyses could lead to fuller and more nuanced understandings about the relationships between peoples' intersectional identities and their retention behaviors or career outcomes.

It is not entirely clear why the first-school retention of *Black-Latinx Insiders* would be markedly better than that of their counterparts and, in particular, *Elites*. A possibility, consistent with the literature on community-based teachers (e.g., Gist et al., 2019), is that *Black and Latinx community insiders* stay in first schools as a result of their ties to local communities and particular commitments to teaching Black and Latinx students in NYC public schools. For their part, *elite college graduates* may find it easier to leave their first schools because they are less rooted in or committed to teaching in

neighborhood urban schools. Or, it may be that their high rate of school attrition is due to their having higher status or higher paying career alternatives (Kelly & Northrop, 2015). These possibilities are not mutually exclusive and we explore them in a follow-up paper on the career decision-making and trajectories of *elite college graduates* and *Black and Latinx community-insiders* (Brantlinger et al., 2022).

The current study also illustrates how longitudinal analyses might help to advance research on early-career teacher retention. For example, by tracking more than six hundred alternatively-certified mathematics teachers for more than five years, this study showed that the main drivers of early-career teacher retention seem to vary over time. This is consistent with research on teachers' career trajectories (e.g., Huberman, 1989) which has shown that the reasons teachers stay or leave depend on their career stage, and that as they gain experience teachers' life circumstances change (e.g., they begin families), which can influence their retention behaviors (Brantlinger, 2021; Mowday et al., 2013). There is a need for more longitudinal research on early-career teacher retention as the extant research generally only tracks teachers through their first or second year or, alternatively, collects data on their retention intentions, often at the end of a pre-service program. While helpful, these studies leave gaps in our understanding and may lead to overgeneralizations. For example, conclusions drawn about first-or second-year teachers might be extended to third- and fourth-year teachers even when they do not apply, whereas findings based on teachers' intended retention may not hold for their observed turnover (Grant & Brantlinger, 2022b).

### Significance for Policy and Practice

Teacher turnover presents a serious challenge for many schools, including those that serve low-income students of color (Carver-Thomas & Darling-Hammond, 2017; Sutchter et al., 2016). Although some teacher turnover can be beneficial, high rates result in negative consequences for schools and the people in them (Ronfeldt et al., 2013; Sorensen & Ladd, 2020). Early indications are that the COVID-19 pandemic and the subsequent Great Resignation will increase teacher turnover (Steiner & Woo, 2021; Streeter, 2021). Teacher turnover and shortage issues may be particularly dire in many lower-income schools that have faced longstanding shortage and turnover issues (Liu et al., 2008).

Shortage issues, in combination with declining enrollment in traditional teacher certification programs, suggest that fast-track alternative certification programs like NYCTF will continue to recruit and train a large proportion of new teachers for the foreseeable future. In the years immediately preceding the pandemic, an increasing share of new teachers nationally were entering through alternative route programs (Yin & Partelow, 2020). Approximately one-quarter of newly-certified U.S. teachers entered through alternative routes in 2019, up from about 15% just a few years prior in 2015. Alternative route teachers generally begin teaching in low-income neighborhood urban schools (Carver-Thomas & Darling-Hammond, 2017).

With this in mind, the modelled retention results (Table 3) point to two particular ways that fast-track training might be modified to improve the retention of alternative route teachers in these schools. First, the strong positive relationship between effective Fieldwork Advisories and first-school retention indicates that alternative route teachers benefit from well-designed practicum seminars that help them to reflect on their experiences in practice teaching settings while addressing their pressing concerns about instruction and classroom management. As noted, irrespective of their subgroup membership, assignment to an effective Advisory was associated with a 47.4% increase in the odds of a NYCTF mathematics teacher remaining at three years and a 67.9% increase in their odds of remaining at five years, relative to their peers assigned to ineffective Advisories.

Second, the modelled retention results (Table 3) also suggest that *elite college graduates* and *community-insiders* benefitted differently from individual approaches to initial teacher training. For

example, in NYCTF, developmental training was associated with increased odds (of about 38.8%) of *Elites* staying for three years in their first schools but reduced odds (of about 51.9%) of their non-elite counterparts doing the same. This and similar results suggest that teacher certification programs should investigate how certain types of teacher candidates experience and interact with certain approaches to, or features of, initial preparation. This might lead to the modification of that preparation or to differentiated training that meets the felt or observed needs of teachers from different program subgroups.

The study's implications for the recruitment and selection of mathematics teachers for schools that serve lower-income communities of color are clear. Specifically, given their comparatively high rates of first-school retention, this study clarifies that district-specific teacher preparation programs like NYCTF could do more to recruit and develop Black and Latinx community-insiders. As do others (e.g., Carver-Thomas & Darling-Hammond, 2017; Gist et al., 2019), we assume that, in most school districts, there is a talented pool of prospective community-based teachers that could be incentivized to teach in local schools. However, it may be that NYCTF and other similar programs need to do more than provide subsidized master's certification coursework and a fast-track to paid teaching to incentivize prospective community-based teachers to enter teaching. That is, the incentives that attract *elite college graduates* to teaching may be insufficient, or possibly ill-suited, for community-based teachers, in particular given that the latter tend to come from less economically privileged backgrounds (see Brantlinger et al., 2022). Related, although NYCTF and Teach For America have demonstrated that sizable numbers of *elite college graduates* can be incentivized to teach in low-income, high-minority schools, this study questions the wisdom of this practice. *Elite college graduates* who became NYCTF mathematics teachers were particularly prone to leave their first school in their first year and, in so doing, exacerbated turnover and shortage issues in these generally hard-to-staff schools.

### Limitations

Although there are several study limitations, four are particularly important to address. First, the quantitative measures of initial training only served as rough approximations of NYCTF's training. In particular, qualitative research on NYCTF training suggests that none of the university partners for secondary mathematics necessarily provided high-quality training for secondary mathematics teacher candidates who would teach in high-minority schools (Brantlinger & Smith, 2013). Not unrelated, the study findings are potentially limited in their generalizability due to the specificity of the teachers in this sample, namely, NYCTF secondary mathematics teachers beginning in 2006 or 2007. Future retention studies would need to probe how similar findings may or may not hold for other samples of teachers.

Second, the analysis did not distinguish between voluntary and involuntary turnover. Although our interpretation made no assumptions about the voluntariness of retention, and to some extent this was not our concern, this was most relevant to the Year 1 retention model in Table 3. In particular, drawing on survey data not used in this study, Brantlinger (2021) estimated that about 20-25% of the NYCTF mathematics teachers' first-year turnover was involuntary; in the majority of cases, it involved school administrators dismissing a first-year teacher with a few weeks remaining in the school-year. He also found that involuntary turnover fell to 10% in the teachers' second year and below 5% annually in subsequent years.

Third, the use of a stepwise procedure raises methodological questions. Smith (2018), a critic of stepwise procedures, argues, "the more variables that are considered, the more likely it is that coincidental statistical relationships will be discovered" (p. 32). However, his critique centers on stepwise analyses that select from hundreds of candidate variables. In this study, the stepwise procedure was limited to selecting from 30 two-way interaction effects and none of the main effects.

This study also meets the standards for stepwise procedures proposed by quantitative methodologists. In particular, Bursac et al. (2008) show that, given a list of possible explanatory variables, the stepwise approach is more likely than not to arrive at the ‘best’ or ‘optimal’ logit model when there are more than 360 observations. This study more than met this threshold by including just under 600 observations of first-school retention for each of the modelled years.

Fourth, although we were guided by policy debates about what types of teachers should be recruited to teach in lower-income urban schools, the way in which teacher subgroups were constructed may have influenced results or points of emphasis. In particular, we defined the two community insider subgroups using information about the location of the high schools they graduated from and about their race and ethnicity. However, the community-insider subgroups might also be broadened to include those teachers who were settled in NYC when they applied to NYCTF and, specifically, second career teachers who had worked in the city for five or more years prior to entry.<sup>8</sup> We also might have used information about the teachers’ race and ethnicity to construct the subgroups differently; for example, by looking only at *Black Insiders* or including *Asian Insiders* in the same group as the *Black-Latinx Insiders*.

## Conclusion

This study used an interactional and intersectional approach to examine how the determinants of retention varied among different mathematics teacher subgroups from one large alternative teacher certification program. Theoretically, the study illustrates the potential of conceptualizing teacher preparation as forming an interactive system. Empirically, the results support the claim that different teacher subgroups benefit differently from the same approach to initial preparation. The retention models also clarify that *Black and Latinx community-insiders* had significantly higher rates of first-school retention at three and five years than *elite college graduates* and that this outcome was largely independent of the initial training they received and the context of their first schools. From a district or program perspective, this suggests that *Black and Latinx Insiders* are a much better investment of limited public funds than *elite college graduates*.

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<sup>8</sup> Brantlinger (2021) compares the career trajectories of first- and second-career mathematics teachers in NYCTF.

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