Teacher Preparedness and Retention

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Abstract

Teacher educators, policy makers, and school administrators have long been concerned with new teachers' initial preparedness to teach. However, how to conceptualize and to validly measure teacher preparedness and the extent to which it is predictive of teacher retention are not entirely clear. This longitudinal study draws on data on hundreds of mathematics teachers to examine the relationship between their initial feelings of preparedness and their retention. The study finds that both math-specific and subject-general measures of mathematics teachers' feelings of initial preparedness predict their 5- and 8-year retention in first schools, their 8-year retention in the district that hired them, and their 8-year retention in the profession in general.

Introduction

There is widespread agreement that high-quality and equitable education requires well-prepared teachers to persevere, if not thrive, in their initial years in

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the classroom and who will remain in teaching after (generally) improving through practice in their initial years. This is particularly true in urban school districts in the United States, where many teachers enter through fast-track alternative-route programs, are often underprepared to teach, and leave neighborhood schools—if not teaching—at high rates (Brantlinger, 2020, 2021; Darling-Hammond et al., 2002; Grant & Brantlinger, 2022; Redding & Smith, 2016; Zhang & Zeller, 2016). Though conceptions and measures of initial teacher preparedness vary, a U.S. Department of Education report (Lewis et al., 1999) stated, "Teachers' feelings of preparedness are one important indicator of the extent to which they are prepared to meet the challenges that characterize their profession" (p. 55). The report conclusion, echoed by other scholars (e.g., Darling-Hammond et al., 2002; Ronfeldt et al., 2014), posited that teacher feelings of initial preparedness (TFIP) are likely predictive of their retention. However, the empirical evidence for the relationship between TFIP, or any other indicator of teacher preparedness for that matter, and teachers' actual retention is weak at best.

Because researchers have made some headway in understanding the relationship between preparation and TFIP (e.g., Caprano et al., 2010; Darling-Hammond et al., 2002), to advance the field, in this quantitative study, we investigate whether alternatively certified mathematics teachers' feelings of initial preparedness predict their retention in New York City (NYC) public schools and their first school in that district at 5 and 8 years. Conceptualizing preparedness as multidimensional, we look specifically at multiple measures of TFIP, such as preparedness to build rapport with students, drawing on data from hundreds of teachers who began teaching secondary mathematics in NYC public schools in the mid-2000s through the New York City Teaching Fellows (NYCTF) program, a nationally prominent alternative-route program.

Literature Review

This section reviews the literature on teacher preparedness through the lens of the conceptual underpinnings of this study. The first subsection concerns the way the field has conceptualized and measured TFIP. The subsequent subsections address what researchers have assumed influences it, namely, teacher characteristics, formal training, and school contexts. The final subsection summarizes the evidence and theory that examine the link between TFIP and retention.

Measuring Teachers' Feelings of Initial Preparedness

Teacher preparedness may be thought of as "what the teacher brings to the classroom from preservice training and on-the-job learning" (Parsad et al., 2001, p. 9). It can be measured in a variety of ways, including with performance-based measures like the edTPA, value-added models of student achievement, and administrator observations of novice teachers' instruction (see, e.g., Beare et al., 2012).

TFIP is a commonly used measure of teachers' self-reported initial preparedness to teach and an indicator of the efficacy of teacher preparation programs or singular approaches to initial teacher preparation (e.g., Bastian et al., 2021). The widely used Schools and Staffing Survey (SASS), for example, measures TFIP, incorporating data from survey items that ask teachers to reflect on their feelings of preparedness for their first year, regardless of how long ago that was.

An issue is that teachers' reflections on their TFIP likely change as they gain experience. For example, Ronfeldt et al. (2014) found that when asked to reflect on their first year, fifth-year teachers had TFIP scores one-third of a standard deviation lower than the first-year teachers taking the same survey. This suggests that along with experience comes insight about what they were not well prepared to do, what they might have done better, and what they did not initially fully understand about teaching and their school context.

Researchers, particularly those who use the SASS, typically use factor analyses of Likert-scale items to construct single, continuous measures of *general or overall TFIP* (e.g., Brantlinger et al., 2022; Kee, 2012; Redding & Smith, 2016). Although useful in advancing our understanding of initial teacher preparedness, the use of single measures of TFIP implies that preparedness is unidimensional and varies on a linear continuum from unprepared to well prepared. Given the complexity of teaching, it is likely that teacher preparedness is multidimensional and, as such, that no single measure can adequately capture the multiple, complex, and varied skills and understandings that teachers employ and therefore feel prepared or unprepared to do or use.

With a few exceptions, the literature largely does not differentiate between preparedness for different aspects of teaching, such as connecting with students, teaching science, technology, engineering, and mathematics (STEM) subjects using inquiry methods, and administrative duties. The Casey and Childs (2011), Fontaine et al. (2012), and Matsko et al. (2018) studies are exceptions for including multiple, continuous measures of TFIP. Particularly relevant to the current study, Boe et al. (2007) differentiated between TFIP to carry out subject-general (e.g., classroom management) and subject-specific (e.g., sequencing mathematics tasks) aspects of teaching.

Teacher Characteristics, Prior Experience, School Contexts, and Their Initial Preparedness

The literature on teacher preparedness has generally focused on the relationship between initial teacher preparation and TFIP. For example, Caprano et al. (2010) found that preservice teachers who learn about inquiry through conducting action research in their field placements report feeling significantly, if modestly, better prepared to teach than teachers in the same program who did not. Teachers prepared in fast-track alternative-route programs—in which participants become teachers of record before completing the full slate of preparation necessary for standard initial

state certification—consistently have been found to feel significantly, if modestly, less well prepared to teach initially than have those from traditional certification programs (Darling-Hammond et al., 2002; Kee, 2012; Redding & Smith, 2016; Zhang & Zeller, 2016). The content of initial teacher preparation may also influence TFIP. In a study of mathematics lesson planning involving 130 early-career elementary teachers, Morris and Hiebert (2017) found that teachers "attended more often and more completely to . . . key [mathematics] concepts when completing a lesson planning task for topics covered in the mathematics content courses for elementary PSTs than for a topic not covered in the courses" (p. 553). This suggests that new teachers are and feel better prepared to plan and possibly teach mathematics lessons that focus on students' conceptual understanding if they studied these key concepts in-depth themselves.

Some literature has suggested that certain teacher characteristics, such as race, age, and gender, relate to their TFIP (Johnson et al., 2005; Kee, 2012). However, as indicated, few if any quantitative studies have directly examined the relationship between teacher characteristics and TFIP. An exception is Brantlinger et al. (2022), who, drawing on the same project data as the current study, found that, for Black teachers, an increase of the proportion of Black students in their schools was significantly and positively related to their general TFIP. This is consistent with research that has shown that the extent to which teachers share or "match" the socioeconomic, ethnoracial, and cultural backgrounds of their students can influence their effectiveness teaching those students (see, e.g., Alexander et al., 1987; Redding, 2019). This, in turn, may influence their feelings of preparedness.

The literature has also suggested that new teacher preparedness and their TFIP are likely related to the school and classroom contexts in which they teach (Johnson et al., 2005). Although not examining the relationship directly, Darling-Hammond and colleagues (2002) suggested that "the kind of school where a teacher begins teaching" (p. 293) may impact their TFIP. Redding and Smith (2016) asserted that alternatively certified teachers' modestly lower levels of TFIP relative to traditionally certified teachers are, in no small part, rooted in the fact that the former begin in schools with more "challenging working conditions" (p. 1089). Although controls for school context are frequently included, extant quantitative studies have provided little additional insight on the relationship between TFIP and the characteristics of schools and students.

Preparedness and Retention

As indicated, although many researchers assume that teachers' initial preparedness is predictive of their retention, this assumption has rarely been tested directly. For example, although Ronfeldt et al. (2014) showed that certain variables (e.g., weeks of practice teaching) predicted both teacher retention and TFIP, they did not directly examine the relationship between the two. Zhang and Zeller's (2016) longitudinal interview study, which tracked 60 new teachers over 7 years, showed that, in comparison to those who

were traditionally prepared, those from alternative-route programs had lower levels of TFIP and left at higher rates. Similarly, in a study of (mostly) early-career teachers from a master's certification program, Van Zandt Allen (2013) found that those who participated in a summer induction program reported feeling better prepared to teach but also were retained in teaching at a higher rate than those who did not. However, neither Zhang and Zeller (2016) nor Van Zandt Allen (2013) accounted for differences in the teachers' first-school contexts and their self-selection into different programs, which meant that one or both of these might have actually explained their results about different levels of TFIP, rates of retention, and the relationships between the two. Finally, two descriptive studies found significant positive relationships between TFIP and teachers' plans to stay in teaching (Darling-Hammond et al., 2002; Fontaine et al., 2012). However, at best, teachers' retention intentions may only weakly relate to actual retention behaviors (Grant & Brantlinger, 2023).

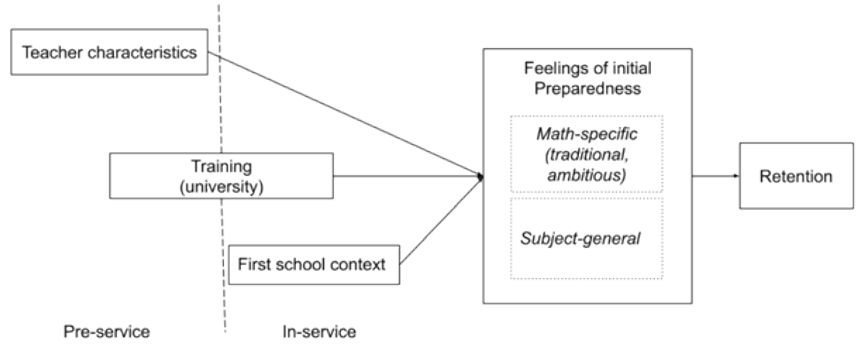
The one prior quantitative study, by Redding and Smith (2016), that has directly examined the link between TFIP and teachers' observed retention did not find it to be significant. However, this may have been an artifact of the authors' reliance on a single, subject-general measure of TFIP. Although they did not use TFIP measures, Bastian et al. (2021) found a relationship between new teachers' perceptions of preparation quality (i.e., quality for instruction, teaching diverse learners, supportive learning environments) and their early-career retention. This suggests that conceptualizing and measuring TFIP as multidimensional might be a productive way to advance the literature on preparedness and teacher retention.

Conceptual Framework

Our conceptual framework is informed by the literature reviewed and is captured in Figure 1. Figure 1 depicts the two relationships we propose to test: the hypothesized characteristics and experiences that predict TFIP and the assumed relationship between preparedness and turnover. Starting on the left, during preservice preparation, teacher-stable characteristics—such as gender, college major, and age—may be associated with different levels of TFIP. Next, training straddles both preservice and in-service experiences, as many teachers begin training prior to their entry into the classroom but continue it during their early in-service work. After entering their first-school contexts, new teachers put their training into practice. Finally, consistent with Matsko et al. (2018) and Fontaine et al. (2012), we conceptualize TFIP to teach as being multidimensional, with some dimensions that are *subject-specific* (e.g., teaching inquiry mathematics) and some that are *subject-general* (e.g., preparedness to build rapport with students in urban schools). Finally, informed by the Bastian et al. (2021) study, we hypothesize a relationship between teachers' multidimensional feelings of initial preparedness factors and their retention, with lower preparedness on certain dimensions corresponding with lower odds of a teacher staying.

Figure 1

Conceptual Framework Relating Teacher Preparation, Preparedness, and Retention



Research Question

The present study addressed the following research question: What is the relationship between mathematics teachers' TFIP and their actual retention in their first schools, the district that facilitated their entry into teaching, and the profession as teachers or administrators? This question addresses retention of teachers using multidimensional measures of TFIP, specifically including two that are subject-specific and two that are subject-general, which would appear to better capture the complex nature of teaching than a single measure. Retention refers to the teachers' observed retention in both their first schools and the NYC public school district.

Methods

Study Context

The sampled teachers all entered through the NYCTF program, a fast-track alternative-route program to initial certification. NYCTF is "selective" in the sense that it recruits elite college graduates and professional career changers, some of whom were leaving prestigious jobs in such fields as investment banking and engineering, and trains them to teach core subjects like mathematics in hard-to-staff public schools (Brantlinger, 2021). The apparent effects of NYCTF training on multiple outcomes—including mathematics teaching, teacher quality, and effectiveness—is explored elsewhere as part of the larger, mixed-methods project from which this study draws its data (see Brantlinger et al., 2022; Meagher & Brantlinger, 2011).

Upon successful completion of the program's 200-hour summer preservice training, which included 60 hours of clinical fieldwork, the teachers became initially certified to teach secondary mathematics. During their first 2 years in the classroom, the teachers taught full-time while also completing master's certification courses

at one of NYCTF's university partner campuses two or three evenings a week. NYCTF teachers were restricted to teaching positions in "high-needs" neighborhood schools in different regions throughout the city—depending on their place of residence. Their students were lower income with, on average, 78.4% receiving free or reduced-price lunch in these schools. Also, most were Latinx and Black; on average, the students in their first schools were 48.5% Latinx, 37.6% Black, 6.9% Asian, and 6.5% White.

Observations of nine case study NYCTF mathematics teachers, conducted from 2006 to 2008, indicated that, as a group, in their first two years in the classroom, they were underprepared to teach mathematics from an inquiry perspective (e.g., mathematics for understanding) and struggled to develop productive relationships with their students—most of whom were Black and/or Latinx (Brantlinger, 2020; Cooley et al., 2021; Meagher & Brantlinger, 2011).

Local labor market conditions might have influenced the study teachers' retention (see, e.g., Goldhaber & Theobald, 2022). They were in their first or second year when the 2008 Great Recession began. At that time, 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 spurred some of the career changers in the study to enter and remain in teaching until more attractive employment opportunities were available (Hurst & Brantlinger, 2022).

Teacher Sample

The larger project sample included 617 NYCTF mathematics teachers who entered the program in either June 2006 or June 2007. This accounts for more than 97% of the teachers who entered teaching through one of those two cohorts. In late 2015 and early 2016, 389 of these teachers took a "career trajectories" survey (described later). For this study, we restricted the study sample to 307 teachers who took that survey and taught for 3 or more years in any K–12 setting inclusive of, but not limited to, NYC public schools. We did so to eliminate nonresponse bias that resulted from teachers who left the district *during* their first year, who were approximately half as likely to complete the survey as all others. We additionally restricted our sample in this way to eliminate recall bias from teachers who had limited classroom experience and, as a result, limited perspective on their preparedness. Our measures of TFIP thus draw on teachers with at least 3 years of experience who reflected on their preparedness to carry out various tasks of teaching in their first year, with the insights that likely come from being in the classroom for a minimum of 3 years.

Table 1 provides descriptive statistics for the study sample of NYCTF teachers who taught for 3 or more years. On most measures, the study sample teachers did not differ significantly from the 617 project sample teachers. For example, there were similar proportions of male teachers, Black teachers, Latinx teachers,

city high school graduates, and elite college graduates, and they had similar rates of 5- and 8-year retention. However, the study sample teachers were significantly less likely than the project sample teachers to be career changers (36% vs. 39%), to be non-White (44% vs. 48%), and to have completed a STEM degree prior to entering the NYCTF (26% vs. 30%).

Data Sources

Administrative Data

The district provided service history data for almost all 617 of NYCTF's mathematics teachers who entered paid teaching in the district in either fall 2006 or fall 2007. Spanning the period from 2006 to 2016, these data included information about their first-school assignments, roles (e.g., assistant principal), and status in the district (e.g., excessed, temporary leave). Survey data were used to address missing service data for 22 teachers. Additionally, New York annually makes data for most of its

Table 1
Descriptive Statistics for the Study Teachers

	Percentage
Characteristic	
Male	45
Latinx	8
Black (non-Latinx)	21
White (non-Latinx)	58
City high school graduate	30
Elite college graduate	29
STEM degree	27
Career changer	35
First school	
Student attendance rate	87
Subsidized lunch	78
Black students	38
Latinx students	49
Retention	
First school at 5 years	39
First school at 8 years	22
District at 5 years	66
District at 8 years	49
Profession at 5 years	84
Profession at 8 years	66

Note. n = 307. Given our interest in the preparedness of teachers to teach in predominantly Black and Latinx schools, there are separate categories for Black and Latinx teachers, whereas the comparison group combines White and Asian teachers. STEM = science, technology, engineering, and mathematics.

public schools publicly available. This includes data on student attendance, student subsidized lunch (i.e., free and reduced-price lunch), and percentage minority students. We used school identifiers to link teacher service history data to school data.

Survey Data and Preparedness Inventory

Beginning in fall 2015, we contacted secondary mathematics teachers from NYCTF's 2006 and 2007 cohorts, asking them to complete our career trajectories survey. We had received most of their email addresses from the NYCTF administrators or the teachers themselves from earlier project surveys. We found some missing email addresses using search engines and social networking sites. The contact email included a detailed description of the research project and a link to the online survey. The teachers were paid $150 for survey completion with the caveat that they could choose to respond or not respond to any part of the survey without needing to explain their nonresponses. The career trajectories survey included an inventory of their retention in K–12 education as teachers, teacher leaders (e.g., department chairs), or administrators and a TFIP inventory. This roles and retention inventory consisted of two tables, the first of which allowed the teachers to report the roles (e.g., mathematics department chair) they held annually in NYC public schools and the second of which allowed them to report these roles if they had moved to another K–12 district or organization (e.g., private or charter school). The TFIP inventory was modeled off a similar, shorter, subject-general inventory included on the SASS. In developing the TFIP inventory, we consulted the literature on teacher preparedness, inquiry-based or ambitious instructional reforms of secondary mathematics, and culturally responsive pedagogy. To improve its content and face validity, three experts in mathematics education reviewed the inventory. Among other recommendations, they encouraged us "to [make] sure that the survey items reflect the breadth of the recommendations in some external National Council of Teachers of Mathematics" and, related, to include questions about such practices as promoting "student sense-making in mathematics" and "anticipating students' misconceptions." As part of validation, we also conducted cognitive interviews with a dozen mathematics teachers—several from NYCTF but none from the study sample—as they completed certain survey sections. These teachers helped with clarifying terms and questions and suggested questions or items.

Measures

Preparedness

The TFIP inventory included 25 Likert-scale items on a 5-point scale ranging from 1 (*not at all prepared*) to 5 (*very well prepared*). It included several items from the SASS instrument (National Center for Education Statistics, 2003), while adding items that specifically addressed preparedness to teach mathematics and to

work with historically marginalized students. Because the TFIP measures were newly developed, we used an exploratory factor analysis to establish the factor structure, resulting in four continuous measures of TFIP. Table 2 presents these measures and, under them, the full list of items and their principal factor loadings. The basic math preparedness measure gauges the extent to which the teachers felt initially prepared to be effective at "teaching the math content to which [they were] assigned" and "using a variety of instructional methods." Contrasting with this measure of TFIP for the "basic skills" of mathematics teaching, the inquiry math preparedness measure gauges TFIP to be effective at teaching mathematics for understanding using inquiry-oriented (i.e., ambitious) practices like "promoting students' abilities to solve unfamiliar or non-routine problems." The growth mind-set preparedness measure assesses TFIP to grow professionally through reflecting on their teaching and the use of formative assessment. The student relations preparedness measure captures TFIP to "build rapport" with their culturally diverse students and also handle classroom management issues. As shown, there was high internal consistency of the items associated with each factor. The bivariate correlations between basic math preparedness, inquiry math preparedness, and growth mind-set preparedness were all greater than .70, whereas their bivariate correlations to student relations preparedness were lower, at .49.

Teacher Background Characteristics

Dichotomous variables for teacher race (i.e., Latinx teacher, Black teacher) and gender (i.e., male) were constructed from the service history data that distinguished between Hispanic and non-Hispanic teachers, categorizing the non-Hispanic teachers as White, Black, Asian, or mixed. Survey data were used to recategorize those teachers labeled as mixed as either Black or Asian. In modeling retention and preparedness, we were interested theoretically in Latinx and (non-Latinx) Black teachers, as most of the students the mathematics teachers taught were Black and Latinx. As such, we included Asian and White teachers together as a comparison group. Survey data were used to create dichotomous teacher-level variables for college selectivity, postsecondary degree prior to entry, high school location, and career changers. In particular, the Barron's 2007 college ranking system was used to distinguish between elite college graduates (i.e., graduates of one of the 85 top-ranked undergraduate institutions of the 250 on the *Barron's* list) and non–elite college graduates (i.e., graduates of lower-ranked institutions on the *Barron's* list and those not on it). Although about 20% of the teachers had completed a master's degree prior to entry, selectivity referred to undergraduate institutions only. The dichotomous STEM degree measure distinguished between teachers who entered the program with a postsecondary degree in a STEM field and those who did not. We included this measure because of our interest in the relationship between teachers' STEM content backgrounds and their preparedness to teach mathematics content. The dichotomous city high school (HS) graduate measure distinguishes between the graduates of high schools, whether

public or private, located in the city and those who did not graduate from a city HS. We included the city HS graduate measure as prior project research had shown it to be predictive of teacher retention (Brantlinger et al., 2022). Finally, consistent with NYCTF's categorization, the teachers who entered teaching within 3 years of having completed an undergraduate degree were labeled recent graduates, and the remainder were categorized as career changers (see also Brantlinger, 2021).

First-School Context

As posited in the theoretical framework, TFIP may be context dependent. For example, teachers' preparedness to build rapport with their students might depend on student attendance. With this in mind, we included the following school-level measures of the percentage of students who (a) received subsidized (free or reduced-price) lunch, (b) were Latinx, (c) were (non-Latinx) Black, and (d) attended school daily. These school-level data were provided by the state. The four measures also were mean centered and non–time varying based on teachers' first years in their first city public schools.

Retention

The service history data, which spanned 8.4–9.4 years, depending on the teachers' year of entry, were used to create dichotomous variables for district and school retention at 5 and 8 years. Eight years was selected based on temporal limits of the data and 5 years because it is a common referent in the literature as a major point in a teacher's career trajectory. The cut points of 4.9 and 7.9 years were used to convert the continuous retention measures to the dichotomous variables of retention at 5 and 8 years. Those cut points were chosen from naturally occurring breaks; no teacher had a service history total between 4.7 and 4.9 years, and only two had a total amount between 7.7 and 7.9 years. Thus these cut points distinguished teachers who left a few months prior to completing 5 and 8 years from those who completed 5 or more or 8 or more full school years. Furthermore, although all began as mathematics teachers, the retention measures referred to the teachers' retention in any paid role in either the district or their first schools. Measures of the teachers' professional retention were constructed from their self-reported retention data on the 2016 survey. Specifically, merged data from the aforementioned roles and retention inventory were used to construct dichotomous measures of retention in any paid role in a K–12 setting at 5 and 8 years. Notably, more than 98% of study participants retained at 5 and 8 years were working as teachers or administrators.

Validity Issues

Recall Bias and the Dunning–Kruger Effect

The TFIP inventory asked the teachers to report on their feelings of being prepared for their first year in the classroom approximately 7.5 years after they had

completed it. Thus the TFIP data were subject to recall bias. Extant studies of teacher preparedness generally had teachers reflect on their initial preparedness at the end of their first year (e.g., Kee, 2012) or during preservice training (e.g., Ronfeldt & Reininger, 2012). Although recall bias may not be a serious concern for these studies, the Dunning–Kruger effect is. This is the phenomenon that inexperienced or unskilled people tend to overestimate their abilities, whereas experienced or skilled people tend to underestimate them (Dunning, 2011). Related, lacking the wisdom of practice that often accompanies classroom experience, novice teachers might not be very good at assessing their TFIP or, at least, certain dimensions of it. This raises a question about the optimal time to collect TFIP data. A sizable body of literature (e.g., Berliner, 2002) has suggested that, on average, early-career teachers do not reach their full capacity until their fifth year and thus this might be the best time for teachers to assess their first-year preparedness. A related concern is that teachers who leave teaching within their first 2 years might report systematically different TFIP levels than those who remain for longer. As indicated, this was one of the reasons we restricted the main analysis to teachers who remained for at least 3 years in the school district. (However, we tested the robustness of our choice to restrict the sample by analyzing the full set of respondents; this analysis produced similar results and conclusions.)

Assessing Validity Threats

We assessed the threats to validity raised in the previous section in two ways, in addition to restricting the main analysis to teachers who remained in the district for at least 3 years. First, to assess the Dunning–Kruger effect, the TFIP inventory asked teachers to self-report on their TFIP at two points in time: "during their first year" and "during their last/current year of teaching mathematics in any secondary school setting." The teachers' self-reported levels of felt preparedness for their current year were, on average, more than one Likert-scale point higher (on a 5-point scale) than those from their first year (i.e., their TFIP). This is to be expected, as, again, teachers generally gain competence and awareness of their own skills as they gain experience (Tschannen-Moran & Hoy, 2007). Second, for a subset (n = 189) of the teacher sample, we were able to compare the TFIP data from the 2016 survey with TFIP data collected in 2008, just after they had finished their first year of teaching. Specifically, we calculated the correlation coefficients (using Spearman's rho) for four TFIP items included on both surveys. The correlations (using Spearman's rho) for these ranged from reasonably strong (ρ = .533, building rapport with students; ρ = .414, dealing with classroom management) to modest (ρ = .244, teaching the assigned content; ρ = .221, using a variety of instructional methods). This suggests that teachers' self-reports of TFIP (i.e., their first-year preparedness) vary with respect to years of experience, depending on the aspect of teaching under consideration. Whether this is due to recall bias, the Dunning–Kruger effect, or something else

is uncertain.

That said, our case study data suggest that it was not recall bias; the teachers' self-reported TFIP scores on the 2016 survey (see Table 2) generally were consistent with the research team's conclusions about the case study teachers' first-year preparedness to teach mathematics in lower-income, high-minority schools

Table 2

The Four TFIP Measures: Factor Loadings and Descriptive Statistics

Factor	*Considering all of my assigned math classes, I generally felt prepared to be effective at . . .*	*First year, mean (SD)*	*Factor loading*
Basic math preparedness[a]	Using a variety of instructional methods	2.83 (1.08)	0.787
	Designing engaging mathematics lessons	2.91 (1.04)	0.778
	Determining students' math knowledge and ability	3.26 (1.00)	0.743
	Teaching math skills and procedures	3.68 (1.00)	0.742
	Letting students know how to improve their class performance	3.20 (1.00)	0.690
	Teaching the math content to which I was assigned	3.79 (1.10)	0.661
Inquiry math preparedness[b]	Promoting student sense-making in math	3.03 (1.03)	0.849
	Promoting students' mathematical understandings	3.21 (0.99)	0.845
	Taking time to consider individual students' math ideas and novel problem solutions with the whole class	2.82 (1.02)	0.825
	Promoting students' abilities to explain and justify their math ideas	2.85 (1.03)	0.824
	Promoting students' abilities to solve unfamiliar or nonroutine problems	2.65 (1.06)	0.823
	Anticipating students' math misconceptions	2.88 (1.08)	0.779
	Asking conceptual math questions while teaching	2.91 (1.09)	0.763
	Interpreting students' mathematical thinking	3.07 (1.05)	0.762
Growth mind-set preparedness[c]	Asking students for feedback on my instruction with the goal of improving their learning	2.67 (1.11)	0.742
	Accessing advice to improve my lessons	3.24 (1.03)	0.740
	Accessing worthwhile mathematical tasks	2.97 (1.04)	0.740
	Using assessment to improve my instruction	2.88 (1.01)	0.719
	Reflecting on my teaching	3.48 (0.99)	0.608
Student relations preparedness[d]	Building rapport with students	3.41 (1.07)	0.855
	Understanding students' cultures and lived experiences	3.09 (1.11)	0.846
	Handling a range of classroom management or discipline situations	2.55 (1.16)	0.786

Note. Responses were made on a 5-point Likert response scale ranging from 5 (strongly agree) to 1 (strongly disagree). Factor loadings are for first-year scores.
aα = 0.848. bα = 0.924. cα = 0.755. dα = 0.770.

(Brantlinger, 2020; Cooley et al., 2021). Specifically, the case study teachers were reasonably well prepared in "teaching math skills" and "teaching the math content to which [they were] assigned" as reflected in the survey sample teachers' scores listed under the basic mathematics preparedness scale. With two possible exceptions, the case study teachers were less well prepared to use inquiry methods as "promoting students' abilities to solve unfamiliar or non-routine problems," as reflected in their generally lower self-reported levels listed for the items under the inquiry mathematics preparedness scale. And, as reflected under the surveyed teachers' self-reports on the student relations scale, though the majority (i.e., five of the nine) case study teachers developed what might be described as productive rapport with their students, to varying degrees, they all struggled with issues of classroom management and discipline.

Logistic Regression Models Predicting Retention

To address the relationship between TFIP and teachers' retention, we used logistic regression (Pampel, 2000). We specifically estimated the coefficients of four binomial logistic regression models for individual teachers remaining in their first schools and the district at 5 years and 8 years. These models were estimated as follows:

$$\ln\left(\frac{\hat{p}}{1-\hat{p}}\right) = \beta_0 + \beta_1\mathbf{X}_1 + \beta_2\mathbf{X}_2 + \beta_3\mathbf{X}_3 .$$

Teachers' retention at each time point was estimated using a logarithmic linking function producing results in log-odds units (i.e., the natural log of the odds ratio) and is predicted by the following vectors of variables: X_1 represents a vector of TFIP, X_2 represents the vector of an individual teacher's characteristics, and X_3 represents a vector of their first-school context. The exponentiation of the coefficients calculates the odds ratios or estimated likelihood of individual teachers leaving their first schools or the district for a given variable.

Although teachers are clustered in schools, fewer than half (43.9%) of the teachers in our sample were placed in schools with other teachers in our sample. This small level of clustering prevented us from using a multilevel modeling approach in our analysis. To test the potential impact of bias from shared variance on our estimates, we examined the intraclass correlations (ICCs) for all of our outcomes. ICCs for the retention outcomes were substantial, for example, above .3 for retention in the teachers' first school at 8 years and greater than .1 for retention in the profession at 8 years. This indicates that the variance in all of the retention outcomes was at least partially determined by school-level factors. Given this, we accounted for the substantial clustering of the variance in the retention models by using cluster robust standard errors.

Results

Descriptive Results

Table 2 presents descriptive statistics of TFIP for the study sample. For many of the individual survey items, the mean scores were near 3 on the 5-point scale, indicating that the teachers "neither agreed nor disagreed" with that preparedness statement and, specifically, that they felt initially underprepared to teach mathematics for understanding, to grow professionally, and to build responsive working relationships with their students. However, looking at the mean scores and ranges of those under each scale suggests that, as a group, the teachers felt initially, if modestly, better prepared to carry out the tasks referenced under basic mathematics preparedness than they were those in other areas (Table 2). In particular, the majority "agreed" with the statements that they were initially prepared to "teach the content to which [they were] assigned" (M = 3.79) and to "teach mathematics skills and procedures" (M = 3.68). With two exceptions, their mean scores for other items under that scale also were at or greater than 3. The teachers seemed to feel less well prepared in other areas and particularly to teach mathematics using inquiry methods. Of the eight items on the inquiry mathematics preparedness scale, seven had mean scores just above or below 3 (i.e., neither agree nor disagree). At 3.21, the mean score for "promoting students' mathematical understandings" was the exception. However, even this score was well below the highest-scoring items under basic mathematics instruction.

Teachers' scores for the two subject-general preparedness measures were somewhat closer (in range) to those for inquiry mathematics instruction than basic mathematics instruction. Under the growth mind-set preparedness scale, collectively, the teachers indicated that they were better prepared initially to "reflect on my teaching" ($M = 3.48$) than to "ask students for feedback on my instruction with the goal of improving their learning" ($M = 2.67$). Under the student relations preparedness scale, as a group, the teachers reported feeling better prepared initially to "build rapport with students" ($M = 3.41$) than to "handle a range of classroom management or discipline situations" ($M = 2.55$).

In a supplementary regression analysis, we explored the TFIP measures' criterion-related validity by modeling the relationship between teachers' individual characteristics and the university training and induction they received in their first-school contexts that were hypothesized to contribute to TFIP (full modeling details and results are presented in a supplementary document available from the first author). In brief, different dimensions of TFIP were differentially predicted by the teachers' prior career status and backgrounds in STEM coursework as well as certain features of the training and induction support they received. For example, university training in inquiry mathematics practices positively predicted higher TFIP on all four scales, whereas background characteristics like being a Black

teacher or a local HS graduate predicted higher levels of TFIP only on the student relation preparedness scale. This evidence in support of the TFIP measures' validity supported our further analysis of TFIP predicting teacher retention.

Modeling the Relationship Between TFIP and Retention

At the broadest level, we find that three of the four TFIP scales were predictive of the mathematics teachers' retention (see Table 3). Basic math preparedness was positively but weakly, $p < .10$, associated with the teachers' first-school retention at 8 years. Specifically, a 1 standard deviation increase on the basic math preparedness scale corresponded with an estimated increase of 68.5% (i.e., from 1.000 to 1.685) in the odds of a teacher remaining for 8 years in their first NYC public school. Basic math preparedness was not associated with any of the other five modeled retention outcomes.

Inquiry math preparedness was strongly negatively associated with the teachers' first-school retention at 5 and 8 years and also weakly negatively associated with their district retention at 8 years. It was not associated with their professional retention. Specifically, a 1 standard deviation increase on the inquiry math preparedness scale corresponded with an estimated decrease of 48.7% (i.e., from 1.000 to 0.513)

Table 3
Logit Models of Teachers' Feelings of Initial Preparedness and Odds of Retention

	First school		*District*		*Professional*	
	5 years	*8 years*	*5 years*	*8 years*	*5 years*	*8 years*
Basic math preparedness	1.359	1.685^{+}	0.856	1.075	0.720	0.811
Inquiry math preparedness	0.513**	0.349**	0.730	0.641^{+}	0.823	0.892
Student relations preparedness	1.356^{+}	1.397^{+}	1.325	1.327*	1.143	1.782**
Growth mind-set preparedness	1.071	1.489^{+}	1.432^{+}	1.237	1.420	0.870
Career changer	0.846	0.869	0.817	1.057	1.246	1.542
Male teacher	1.661^{+}	1.217	1.216	1.081	0.775	1.014
Black teacher	1.989^{+}	0.885	2.617*	1.834	3.772*	1.179
Latinx teacher	1.122	0.992	0.801	0.528*	1.57	0.897
City high school graduate	1.130	1.244	1.586	1.584	0.891	1.609
Elite college graduate	0.786	0.673	0.586^{+}	0.471**	0.654	0.618^{+}
STEM degree	1.129	0.793	0.722	0.736	1.104	0.954
Student attendance rate	1.065*	1.081*	1.031	1.013	1.016	1.011
Subsidized lunch	1.005	1.003	1.001	1.001	1.002	1.003
Black	0.985^{+}	0.974**	0.998	0.987	0.989	0.99
Latinx	0.982*	0.986	0.990	0.982*	0.993	0.983^{+}
Constant	0.446**	0.239**	2.102**	1.012	5.491**	1.733*

Note. $n = 307$. Models are estimated with robust standard errors adjusting for the clustering of teachers at the school level. STEM = science, technology, engineering, and mathematics.
$^{+}p < .10$. $*p < .05$. $**p < .01$.

in the odds of a teacher remaining for 5 years in their first school, $p < .01$; an estimated decrease of 65.1% in the odds of a teacher remaining for 8 years in their first school, $p < .01$; and an estimated decrease of 35.9% in the odds of a teacher remaining for 8 years in the district, $p < .10$.

Student relations preparedness was significantly and positively associated with the teachers' retention in four of the six models; looking at the significance levels, it was weakly associated with first-school retention at both 5 and 8 years, $p < .10$; strongly associated with district retention at 8 years, $p < .05$; and very strongly associated with professional retention, $p < .01$. Specifically, a 1 standard deviation increase on student relations preparedness improved by 35.6% the estimated odds of a teacher remaining for 5 years in their first school, by 39.7% the estimated odds of remaining in that school for 8 years, by 32.7% the estimated odds of remaining in the district for 8 years, and by 78.2% the estimated odds of remaining in the profession. Looking at the survey items that composed the student relations preparedness scale suggests that the odds of teachers remaining in their first schools and the school district were significantly better if they felt initially prepared to "build rapport with [their] students," to "understand students' cultures and lived experiences," and to "manage [their] classrooms." Contrary to what the literature on teacher–student race matching has suggested (e.g., Redding, 2019), the models (available from the first author) that regressed the teachers' preparedness scores against their background characteristics did not show a strong significant relationship between the teachers' background characteristics—and race in particular—and student relation preparedness. That said, the teachers who graduated from a NYC high school scored significantly higher (at the .10 level) on this scale than those who did not.

Growth mind-set preparedness was positively but weakly, $p < .10$, predictive of two of the six retention outcomes. Specifically, a 1 standard deviation increase on growth mind-set preparedness corresponded with an estimated increase of 48.9% in the odds of a teacher remaining in their first school at 8 years and 43.2% in the odds of a teacher remaining for 5 years in the NYC public school district. Growth mind-set preparedness was not associated with any of the other five modeled retention outcomes.

As part of the post hoc analysis, we also reran the regression analyses with the full survey sample (i.e., also including teachers who left the district prior to completing 3 years). These results and a correlation table of the main study variables are available from the first author. The results for the full survey sample were very similar to those reported in Tables 3 and 4 for the main study sample, restricted to teachers who remained in the profession for 3 or more years. This suggests that the teachers' retrospective reporting of their TFIP was not particularly affected by the Dunning–Kruger effect or their years of classroom experience.

Finally, a number of the covariates also were predictive of the teachers' retention at the .05 or .01 level (Table 3). In particular, the estimated odds of Black sample

teachers remaining in the district and profession at 5 years were significantly, $p < .05$, and markedly higher than those of White teachers. The estimated odds of elite college graduates remaining in the district at 8 years were significantly lower than for the teachers who did not graduate from a very selective college. In terms of student characteristics, the student attendance rate in the teachers' first schools was significantly, $p < .05$, and positively related to the odds of first-school retention at 5 and 8 years. The percentage of Black students in their first schools was significantly, $p < .01$, and negatively related to their odds of retention in those schools. The percentage of Latinx students in those schools was significantly, $p < .05$, and negatively related to their odds of retention in their first schools at 5 years and in the district at 8 years.

Discussion

The purpose of this study was to investigate the relationship between different dimensions of mathematics teachers' feelings of preparedness and their retention. We found that two of the four TFIP scales we developed were associated with one or more of the teachers' retention outcomes—one positively and one negatively. The fact that two TFIP scales, one subject-specific (inquiry mathematics preparedness) and one subject-general (student relations preparedness), were predictive (at the .05 or .01 level of significance) demonstrates the value of conceptualizing and measuring TFIP as a multidimensional construct and one that includes subject-specific and subject-general components (see also Boe et al., 2007). Although this is preliminary evidence, we recommend that future studies conceptualize teacher preparedness as multidimensional and that teacher surveys like SASS include preparedness inventories that attempt to capture this multidimensionality.

Of the four TFIP scales, only the student relations preparedness scale was positively and significantly (at the .05 level) associated with the mathematics teachers' retention, in this case, both district and professional retention. This result is consistent with assumptions in the literature about the positive relationship between teacher preparedness and teacher retention (see, e.g., Darling-Hammond et al., 2002). It indicates that early-career teachers may be more likely to remain in a high-minority school district or the teaching profession if, in their first year, they feel better able to build constructive working relationships with their students. Although only significant at the .10 level, student relations preparedness also was positively associated with the teachers' first-school retention at 5 and 8 years. This was a subject-general—rather than mathematics-specific—result that may generalize to other content areas in urban and other ethnoracially diverse settings.

However, we also found that scoring higher on inquiry math preparedness corresponded with lower odds of a teacher remaining in their first school at 5 and 8 years and the district at 8 years (although only significant at the .10 level). This suggests that the field might revise a widely shared assumption about a wholly

positive relationship between teachers' initial preparedness and their retention (see, e.g., Darling-Hammond et al., 2002; Redding & Smith, 2016). That said, the results for inquiry mathematics preparedness may be as much about the "fit" between individual new teachers and the contexts in which they begin teaching (Johnson et al., 2005). In particular, a possible explanation is that, in the period from 2006 to 2008, inquiry mathematics was not supported in many of the city's public schools (Cooley et al., 2021; Meagher & Brantlinger, 2011) and that the study teachers with higher inquiry mathematics preparedness tended to migrate to schools, or even another K–12 setting (e.g., another district or private or charter school), where they could utilize such inquiry instructional skills as "promoting students' abilities to solve unfamiliar or non-routine problems" (Table 2). That at least some of the "inquiry-oriented" study teachers might have been moving from school to school or to a new district or other K–12 setting in search for a more supportive context in which to teach mathematics for understanding also seems consistent with the result that inquiry mathematics preparedness was not associated with the teachers' professional retention at 5 and 8 years.

It also is important to note that, as the descriptive results (Table 2) indicate, few of the NYCTF mathematics teachers reported feeling adequately prepared to teach inquiry mathematics in their first year. This is consistent with case study research on nine NYCTF teachers—all in the current study sample—who showed that they were not prepared, or even unwilling, to teach from an inquiry stance to foster students' conceptual understanding of the subject (Cooley et al., 2021; Meagher & Brantlinger, 2011). With two exceptions, in their first 2 years, the case study teachers relied exclusively on teacher-centered teaching methods. In part, and as some of them pointed out in interviews, this seemed to be due to the inattention paid to teaching mathematics for understanding in NYCTF. In the period from 2006 to 2008, NYCTF mathematics teachers were "fast tracked" into teaching, and, in part because of this, their preservice training exposure to inquiry-teaching methods was, at best, limited (Brantlinger & Smith, 2013). It may be that, were NYCTF to have provided more robust coverage of inquiry-teaching methods, the relationships between inquiry mathematics preparedness and the teachers' retention outcomes we found would have been different. To be clear, the same case might be made for a more robust coverage of topics that fell under the other scales, for example, those under growth mind-set preparedness or student relations preparedness.

Our use of multiple TFIP scales may explain why our retention results contrast with those of Redding and Smith (2016), who, in the one prior quantitative analysis of teachers' feelings of initial preparedness TFIP and their retention in the profession, found them to be unrelated. In contrast to our study, their study used only a single, subject-general measure of TFIP derived from SASS data. Consistent with this, in a post hoc analysis using a general measure consistent with their SASS measure, we did not find a significant relationship between TFIP and the teachers' school or district retention (see also Brantlinger et al., 2022). As we argued earlier,

this suggests that the field would benefit from conceptualizing and measuring TFIP as a multidimensional construct.

Limitations

This study has several limitations. First, it relied on teachers' retrospective survey reporting about their career decisions. Participants' memories about events can change over time, and in some places, they might provide socially desirable responses. Second, and related, the survey asked the teachers to report on their preparedness for their first year approximately 9 years after they had entered teaching. It is important to note that other research has faced this same limitation; in particular, drawing on a nationally representative teacher sample, SASS asks experienced and inexperienced teachers alike to reflect on their first-year preparedness.

Third, as indicated, survey selection bias also was an issue, as NYCTF mathematics teachers who left the district during their first year were undersampled. Teachers who left the district during their first year were about half as likely to complete the survey as those who completed at least 1 year of service, which may have influenced the study results. A post hoc analysis indicated that, compared to others, the "earliest" leavers reported feeling less well prepared initially to build relations with students than other teachers in the survey sample. However, a missing data analysis suggested that the survey sample otherwise was representative of the full project sample.

Fourth, being specific to NYCTF mathematics teachers, some of the specific results may not generalize well to other early-career teachers, but we suspect that the multidimensionality element of this study is still applicable. Finally, relative to the other TFIP measures, the student relations preparedness measure was limited with respect to its construct coverage (Table 2). Related, although the survey items that inquired about their preparedness to understand students' lived experiences and build rapport with students seemed fairly clear to us, what teachers think of when prompted about classroom management can be more nebulous. We suspect that, given the positive alignment between the three items used for the student relations preparedness measure, the majority of teachers understood classroom management in a progressive or student-centered light, whereby teachers use their knowledge of students and trust they have built with students to manage the classroom. That said, some of the teachers likely also viewed the same items from a traditional, teacher-centered perspective, focusing on controlling or restricting their students' movement and voice.

Implications and Recommendations

The work of teaching is complex, and as the study suggests, a multidimensional approach to conceptualizing TFIP only begins to capture the complexity of teaching and teacher preparedness. Moreover, one study is almost always insufficient; addi-

tional research is needed to further develop and validate multidimensional measures of TFIP. This study provided some initial construct, discriminant, and predictive validation evidence for our four-factor measures of TFIP through factor and regression analyses. Specifically, we showed that two of the four TFIP scales predicted teacher retention outcomes at the .01 or .05 level and that the other two did so at the .10 level (Table 3). This suggests that future researchers could productively build on our TFIP measures and, given its aforementioned limitations, perhaps construct a more robust measure of student relations preparedness. Existing literature could prove helpful here. For example, based on research on early-career teachers in neighborhood urban schools, Haberman (1995) asserted that "star" teachers—those who are effective and stay at higher rates—take responsibility for student learning (rather than blaming students), do not take student disruptions or behavior personally, and show respect and concern for their students irrespective of their performance or behavior. In terms of better measuring TFIP for classroom management, Schonfeld and Feinman (2012) asked new teachers in neighborhood urban schools to distinguish between major and minor student misbehavior and disruptions and nonviolent confrontations between combinations of students and teachers.

Consistent with the literature on teachers from fast-track alternative-route programs (Darling-Hammond et al., 2002; Kee, 2012; Meagher & Brantlinger, 2011; Redding & Smith, 2016), the sampled NYCTF mathematics teachers' feelings of initial preparedness were not very high on average (Table 2). This supports arguments that, although they may be necessary in the short term, fast-track programs like NYCTF may simply maintain gaps in teacher preparedness, effectiveness, and retention between lower-income neighborhood urban schools and schools in higher-income areas (Brantlinger et al., 2022; Darling-Hammond et al., 2002).

Given the link we find between TFIP and retention, it is important to consider how we might improve teachers' TFIP to facilitate their transition into teaching with the aim of retaining them for the long term. The results about the positive relationship between student relations preparedness and retention, in particular, suggest that initial teacher training should help new teachers learn about the cultures and lived experiences of the Black and Latinx students they will teach and also to build rapport with them. For example, Howard and Milner (2021) argued that, before they enter the classroom, new teachers should take sociological coursework that helps them "build knowledge about and be aware of the racial and cultural background of students to address the needs students bring to school" (p. 228). As the descriptive information on TFIP in Table 2 shows, NYCTF mathematics teachers in this study felt underprepared in other areas as well, indicating that they would have benefited from additional training prior to beginning as full-time teachers of record. For example, and considering the weak, $p < .10$, positive link between growth mind-set preparedness and retention that we found (Table 3), NYCTF teachers' practice and their retention might have benefited from learning more about how to seek feedback from their students and advice from other teachers (Table 2).

Conclusion

In this study, we found evidence that teacher preparedness, and in particular mathematics teachers' self-assessments of their initial preparedness, or TFIP, is related to their long-term retention in their first schools, the school district that subsidized their entry into teaching, and the teaching profession. The study provides preliminary insights about what dimensions of preparedness might be predictive of (alternatively certified) mathematics teacher retention as two of the TFIP measures, one subject-specific and one subject-general, were predictive of the teachers' retention. This suggests that the field move to conceptualizing TFIP as multidimensional and that researchers should develop survey instruments that include both subject-general and subject-specific dimensions of TFIP. As this research is a first step toward understanding what appears to be a somewhat complex relationship between TFIP and retention, future work, both qualitative and quantitative, is needed to better capture and understand the complexity of a broad range of teachers' feelings of preparedness as they enter the classroom.

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