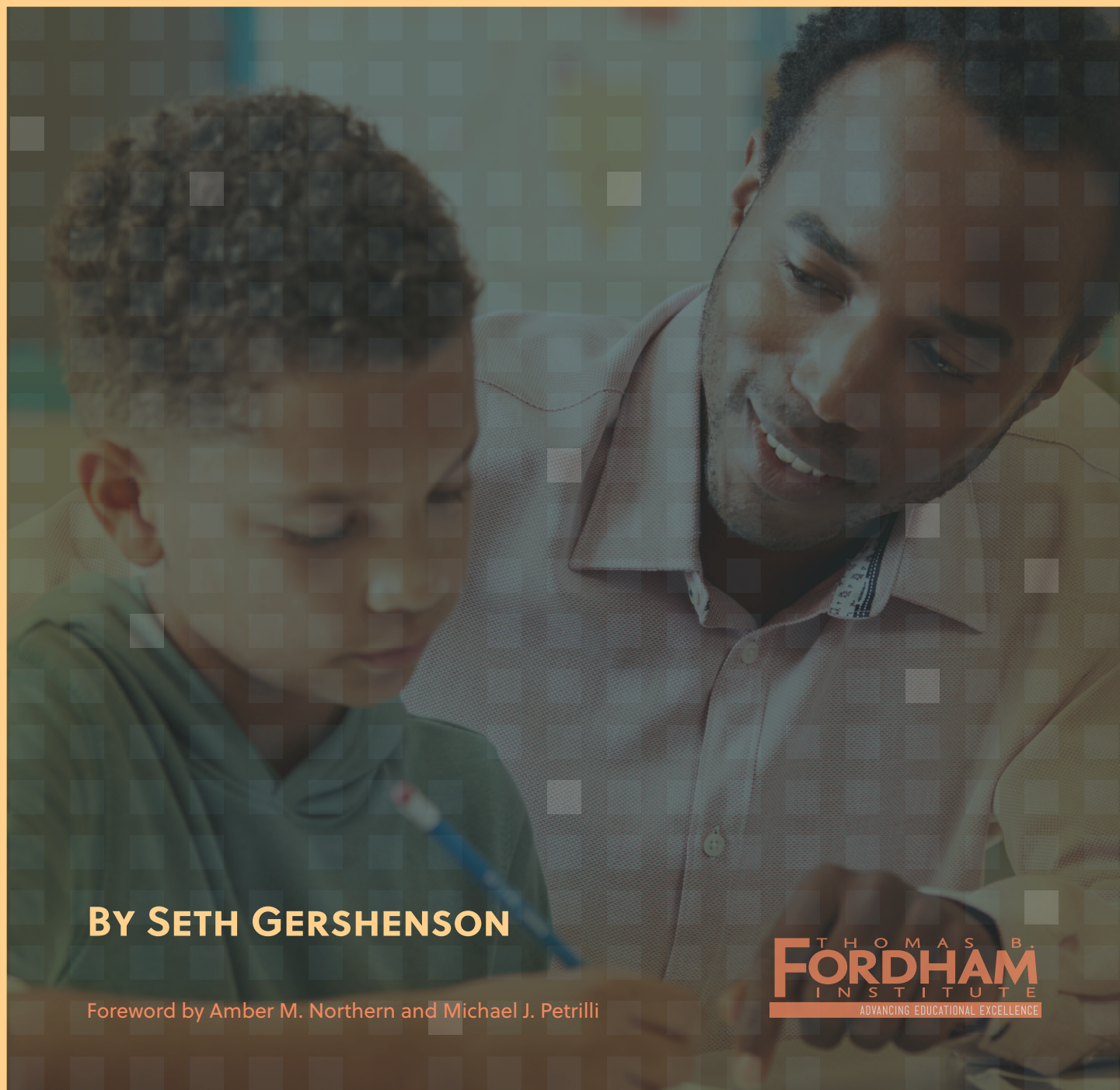# Student-Teacher Race Match in Charter and Traditional Public Schools

By Seth Gershenson

Foreword by Amber M. Northern and Michael J. Petrilli

THOMAS B. FORDHAM INSTITUTE

ADVANCING EDUCATIONAL EXCELLENCE

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Foreword

By Amber M. Northern and Michael J. Petrilli

As conservatives working in education, we find ourselves drawn to Chief Justice John Roberts's observation that "it is a sordid business, this divvying us up by race." Along with Dr. King, we want to believe in a world where everyone is judged by the content of their character, not the color of the skin. And as such, we tend to think that teachers should be hired based on the quality of their instruction and their fit with a school's mission—not their race or ethnicity. So we've been skeptical, even uncomfortable, about efforts to "match" students and teachers based on their race.

As the literature on "student-teacher race match" has expanded, however, we've found ourselves confronted with a simple empirical truth: There's mounting evidence that students who have one or more same-race teachers experience clear advantages, at least some of the youngsters, at least some of the time. We may favor a race-blind world, but for children of color especially, exposure to teachers of the same race over the course of their educational careers seems to make a substantial, positive difference.

Not only have math and English language arts test scores risen significantly for both black and white elementary school students taught by same-race teachers,

> **...[F]or children of color especially, having one or more teachers of the same race over the course of their educational careers seems to make a substantial, positive difference.**

but the impact of having just one same-race teacher during one's time in the lower grades also increases black students' odds of graduating from high school and enrolling in college. These matches also show positive nearer-term impacts on student attendance and discipline. Similar benefits occur in other educational settings, too, including community colleges.

As believers in various forms of school choice, including public charter schools, we naturally wondered whether the success of urban charter schools at boosting achievement and other outcomes might be due to their greater success in recruiting a diverse teaching staff. It stands to reason that schools where the diversity of the instructional team more closely resembles that of the students are likely to have more students of color assigned a

teacher of the same race. Do such matches actually occur more often in the charter sector than in traditional public schools? And if so, are the benefits similar or different between sectors? To our knowledge, nobody had yet investigated these particular questions, so we turned to one scholar we were confident would know for sure: Dr. Seth Gershenson, Associate Professor at American University.

Seth is one of a handful of scholars who first rigorously examined the impact of race match and helped elevate its importance in education policy circles. He's studied not only the long-run impact of same-race teachers on students, but also its effect on intermediate pupil outcomes and on teachers' beliefs. He confirmed that we were entering uncharted territory, and he was eager to augment his existing scholarship.

So began the present study. You can read much more about Dr. Gershenson's findings in the report itself (or executive summary, if you choose). But in a nutshell, he finds that, though white students are about equally likely to have a white teacher in either traditional public or charter schools, black students in charters are about 50 percent more likely to have a same-race teacher than their black counterparts in traditional public schools (even when restricting the comparison to schools in urban areas). He also finds that the impact of having a same-race teacher is twice as large in charter schools as in traditional public schools, though those differences are statistically insignificant, likely due to small sample sizes. Finally, within charter schools, the effect of having a same-race teacher is about twice as large for nonwhite students as for white students.

We don't know for sure whether and why student-teacher race match appears to have a bigger impact in the charter sector, particularly for kids of color. Perhaps there's a compounding effect in some charters with a "high expectations" culture and a sizable proportion of teachers of color who may also have high expectations of same-race students.

> **But what is clear is that charter schools—in North Carolina at least—are doing a much better job recruiting a diverse teaching force...**

But what is clear is that charter schools—in North Carolina at least—are doing a much better job of recruiting a diverse teaching force, and are subsequently more likely to match teachers and students on the basis of race. This may explain at least some of the student achievement advantage that urban charter schools enjoy compared to traditional public schools.

Moreover, amid shameful and bizarre allegations linking charter schools to the era of Jim Crow segregation, it was not lost on us that the effects of student-teacher race match were virtually identical whether a school was mostly white or mostly nonwhite.

Let's repeat that: Not only do urban charter schools—serving mostly children of color— outperform their traditional public school peers when it comes to test scores and other outcomes, they also do a better job recruiting teachers of color, which means that more black and brown kids get the experience of being taught by a same-race teacher.

Now, maybe we are missing something, but that sure sounds progressive to us. One might assume, then, that as the Democratic Party continues to move left, its liberal wing would embrace charter schools. Not so much.

To wit:

1. Writing for In the Public Interest, Jeremy Mohler claims that "Charter schools aren't progressive. They're a way to avoid funding the education of all students."

2. Other Dems agree that "There is no 'progressive case' for charter schools. " And they hassle their charter-supporting brethren at the Center for American Progress "to focus its advocacy on pressuring policymakers and government leaders to provide public schools with the resources they need to attend to the needs of all students rather than advocate for charter schools and other options that actually hurt public schools and the students left in them."

3. The Education Opportunity Network piles on, bemoaning "the longstanding effort by establishment Democrats to boost private operators of charter schools [that] avoid[s] inconvenient truths about these schools and hides its [sic] ideological agenda."

The debate shows no sign of letting up, with presidential hopeful Cory Booker now caught in the crosshairs. A recent headline from New York Magazine says simply, "Cory Booker Has a School Choice Problem." That's because his views on charter schools "have gone out of fashion with many Democrats," which "creates a conundrum for Booker," whose legacy as Newark's mayor was based on the proliferation of charter schools. And all of this is having real-world ramifications, as the Democrat-led House Appropriations Committee recently voted to cut $40 million from the federal charter schools program. (Likewise, presidential hopeful Bernie Sanders recently called for a moratorium on federal funding of charter schools.)

Again, we don't reside on the left, but we find ourselves scratching our heads, given that urban charter schools have been found to be so effective at boosting achievement and college success for low-income kids and kids of color. And that competition from charters seems to help public schools improve, too. Sure seems progressive.

Now here in the present study is more evidence of how progressive charter schools are. They do a better job recruiting a diverse workforce and therefore matching kids of color to teachers of color (mostly because they have more black teachers in the first place). And doing so may help to explain their superior results.

One might hope, like we did, that matching students and teachers by race wouldn't matter in terms of the benefits gleaned by kids. But that's not what the evidence is showing. We think, then, that this latest research provides an opportunity to practice humility on both sides of the ideological spectrum in light of what's best for students.

For those of us in conservative quarters, that means acknowledging that a focus on race is sometimes needed for all students to thrive and shine.

For those in progressive quarters, that means acknowledging that traditional public schools have something to learn from their charter school peers, at least when it comes to recruiting a diverse workforce.

May we all humbly accept the invitation afforded to us!

Executive Summary

There is growing awareness of the benefits of teacher diversity, and specifically of students having access to teachers from the same racial or ethnic background. Several studies have shown that children who have at least one same-race teacher in primary school have fewer absences and suspensions, higher test scores, and are more likely to graduate high school and enroll in college.

But to what extent, if any, do the benefits of having a same-race teacher vary by type of school? We simply don't know, as existing research either focuses exclusively on traditional public schools or fails to distinguish among sectors (e.g., traditional public schools, charter schools, and private schools). Knowing whether differences in student-teacher race match exist across sectors could improve how we recruit and develop educators, as how a school is organized and governed might moderate the benefits of having a same-race teacher. Moreover, greater representation of black teachers might help explain the success of many urban charter schools that serve majority black populations, an explanation that has received short shrift in research and policy circles.

Dr. Seth Gershenson, Associate Professor at American University, investigates these and other topics in the current study. Gershenson has conducted several prior studies on teacher demographic representation and extends that research herein by addressing three key questions:

1. Is student-teacher race match more common in traditional public or charter schools?

2. Is the effect of having a same-race teacher larger in traditional public or charter schools?

3. Do sectoral differences in the same-race-teacher effect vary by schools' locale, size, or demographics?

The study was conducted in North Carolina, a state with a diverse demographic and socioeconomic profile. Although we cannot claim that these findings are applicable to all states, North Carolina's public education system generally resembles those of many other large states, and results there tend to align with those that use nationally representative data.

Gershenson analyzed data from self-contained classrooms, grades three to five, in North Carolina from academic years 2006–07 through 2012–13. This information covers all public elementary school students in the state—traditional and charter—and includes demographic information on students and teachers, end-of-grade test scores in math and English language arts (ELA), and basic school information. The seven-year span allows for within-student comparisons and computation of academic growth from year to year.

Because schools vary in the proportion of black teachers on staff and students are not randomly assigned to schools, Gershenson compares students to others in the same grade who attend the same school in the same year, for a total of 1.8 million complete observations. The study yielded five findings, summarized below with a key figure for each.

KEY FINDING 1: Traditional public schools and charter schools serve the same proportion of black students, but charter schools have about 35 percent more black teachers.

Figure ES-1. While previously overrepresented in North Carolina's charter schools, as of 2013, black students are evenly represented in traditional and charter schools, while black teachers are more likely to teach in the latter.
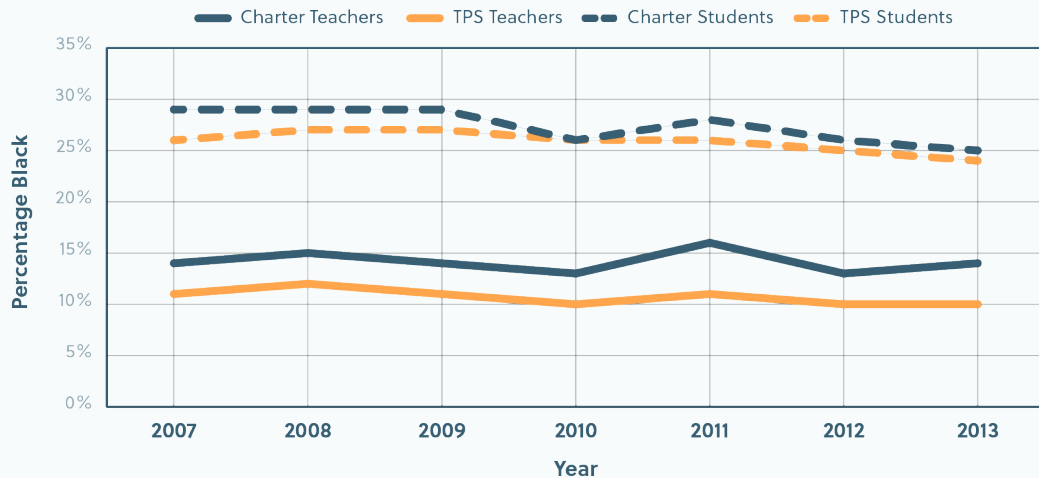
KEY FINDING 2: Black students in charter schools are more than 50 percent (13 percentage points) more likely to have a black teacher than their traditional public school counterparts, but white students are equally likely to have a white teacher across the two sectors.

Figure ES-2. Relative to their black peers in traditional public schools, black students in charter schools are significantly more likely to have same-race teachers.

White Students in Charters · Black Students in Charters
White Students in TPS · Black Students in TPS

Percentage of Students With at Least One Same-Race Teacher
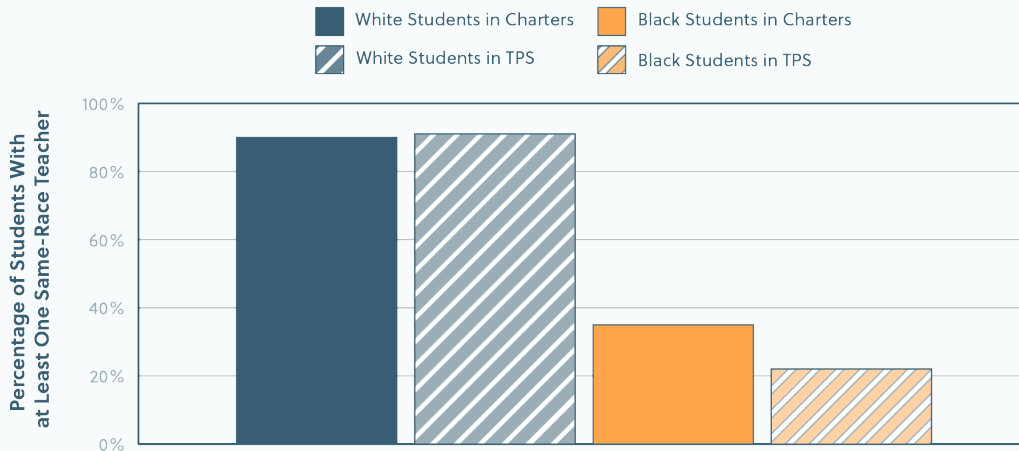
Note: Figure ES-2 is constructed using data from *Appendix A*, Table A-2.

KEY FINDING 3: Race-match effects are nearly twice as large in the charter school sector as in traditional public schools, though these differences are statistically insignificant, likely due to small sample sizes.

Figure ES-3. Overall, same-race teachers boost math performance by almost 2 percent of a SD, but this effect is larger in charter schools than in traditional public schools.

All Schools · Charter Schools · TPS

Effect of Same-Race Teachers on Math Scores (Percentage of SD)

1.8%   3.0%   1.6%
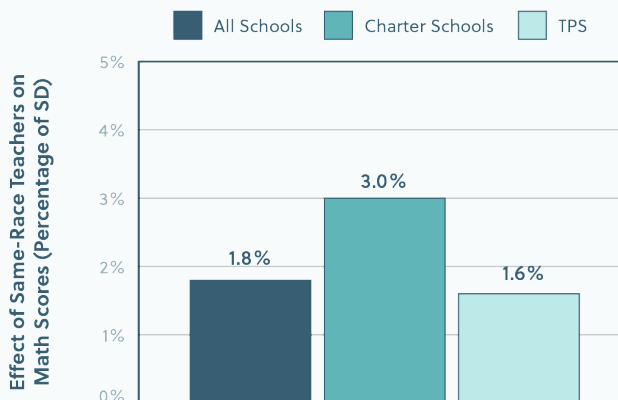
Note: Figure ES-3 is constructed using data from *Appendix A*, Table A-3. All three effects are statistically significantly different from zero. However, the difference between traditional public schools and charters is not itself statistically significant, likely due to the relatively small sample of charter school students.

KEY FINDING 4: In charter schools, race-match effects are twice as large for nonwhite as for white students, while no such difference exists in traditional public schools.

Figure ES-4. In charter schools, the effect of having a same-race teacher on math scores is twice as large for nonwhite as for white students, though no such difference is found in traditional public schools.
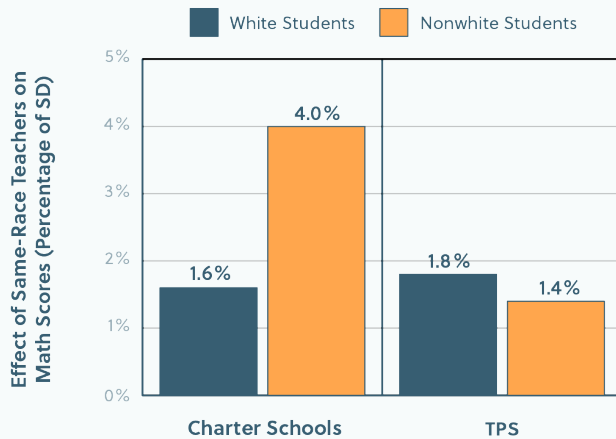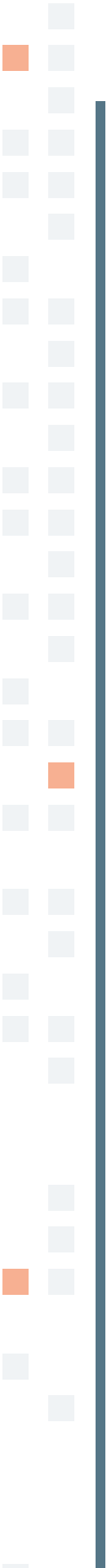
Note: Figure ES-4 is constructed using data from *Appendix A*, Table A-4. Nonwhite includes students of any race other than white. Pooling nonwhite student groups enabled analyses not possible when examining black students separately. The gap between white and nonwhite students in traditional public schools is not statistically significant.

KEY FINDING 5: Race-match effects are relatively constant across school locales, enrollments, and compositions.

Figure ES-5. Race-match effects exist in both charter schools and traditional public schools, though they're larger in charters, regardless of school demographics, locale, or size.
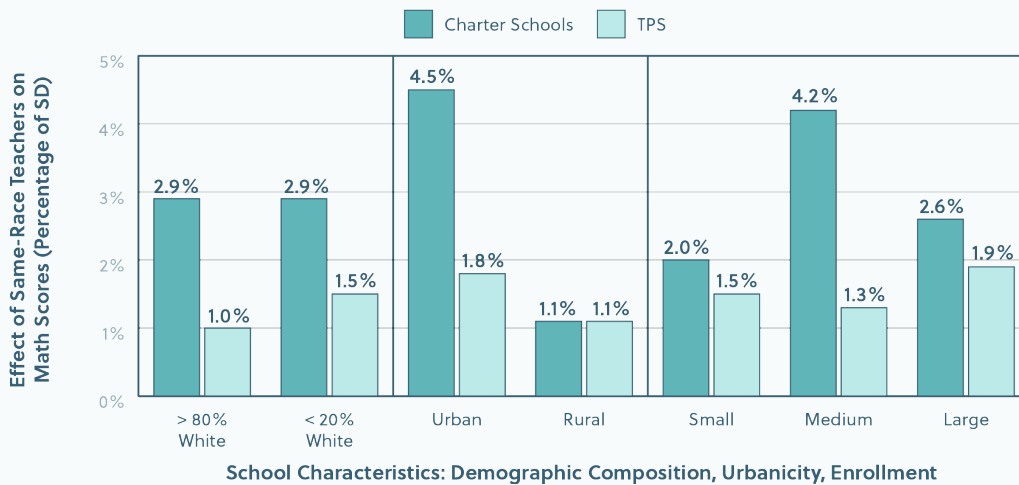
Note: Figure ES-5 is constructed using data from *Appendix A*, Table A-6. All of the traditional public school estimates are statistically significantly different from zero. For charters, only the urban locale and medium school size estimates are statistically significantly different from zero. School size equates to the largest third, the middle third, and the smallest third by student enrollment.

Since the effects of having a same-race teacher appear stronger in charter schools than in the district sector—and stronger still for nonwhite students—it's encouraging that the charter sector has more of these matches between black students and teachers, due largely to having more black teachers in the first place. This is clearly an overlooked dimension of charter effectiveness.

Learning more about these impacts is an area ripe for future research. In the meantime, traditional public schools might seek to emulate their charter school counterparts when it comes to boosting the number of teachers of color they hire, though there remains room for improving teacher diversity, not to mention academic achievement, in both sectors.

Introduction

Large and persistent racial gaps in educational attainment are among the greatest challenges in American education, suggesting that large segments of our population are falling short of their potential while contributing to social division and feelings of injustice. That's particularly troubling since we know that education can boost social mobility, moving many young people out of poverty and firmly into the middle class.

Many factors having to do with "opportunities to learn" boost the odds that young people will succeed, including access to high academic standards, rigorous coursework, and after-school learning opportunities. But what if institutional factors, in particular the racial composition of the teaching force, were also part of the solution? There is growing awareness of the benefits of teacher diversity, and specifically of students having access to teachers from the same racial or ethnic background. In fact, a series of high-profile studies has shown that children who have at least one same-race teacher in primary school have fewer absences and suspensions, higher test scores, and are more likely to graduate high school and enroll in college.[1]

> **But to what extent (if any) do the benefits of having a same-race teacher vary by type of school?**

But to what extent (if any) do the benefits of having a same-race teacher vary by type of school? We haven't known the answer, as existing research either focuses exclusively on traditional public schools (TPS) or fails to distinguish among sectors (e.g., traditional public schools, charter schools, and private schools). Knowing whether differences in student-teacher race match exist across sectors could improve how we recruit and develop educators, as a school's organization might moderate the benefits of having a same-race teacher. Moreover, greater representation of black teachers might help explain the success of many urban charter schools that serve majority black populations, an explanation that has received short shrift in research and policy circles.

This study analyzes differences in student-teacher race match by (public) school sector and thus explores a possible source of charter school effectiveness: greater racial diversity in teaching staffs.[2] Specifically, we address three key questions:

1. Is student-teacher race match more common in traditional public or charter schools?

2. Is the effect of having a same-race teacher larger in traditional public or charter schools?

3. Do sectoral differences in the same-race-teacher effect vary by schools' locale, size, or demographics?

We address these questions using longitudinal administrative data from North Carolina on all grade 3–5 public school students (TPS and charter) from the 2006–07 through 2012–13 academic years.[3] We look at whether having a same-race teacher impacts end-of-grade test scores in math and English language arts (ELA). These methods are explained in *Section III. Methodology* and *Appendix B*, but the essential point is that we control for factors that might jointly influence assignment to a same-race teacher *and* performance on the end-of-grade test, arguably yielding causal estimates of the effect of student-teacher race match on student academic outcomes.

Background

THE RESEARCH ON STUDENT-TEACHER RACE MATCH

The benefits of student-teacher demographic match are well documented in numerous settings. A seminal study by Thomas Dee of Stanford University used experimental data from Tennessee's Student-Teacher Achievement Ratio (STAR) project, in which students and teachers were randomly assigned to classrooms in grades K–3; he found that math and ELA test scores of both black and white primary school students increased significantly in years when the students were taught by a teacher of the same race.[4] Subsequent research has used Project STAR's experimental data, as well as longitudinal administrative data from North Carolina, to show that having even one same-race teacher while in primary school dramatically increases black students' chances of graduating high school and enrolling in college.[5]

> **...[T]here are a number of reasons that race match and its effects might vary between the sectors.**

The basic finding that student-teacher race match predicts higher test scores in at least certain K–8 grades and subjects has been replicated in three states, including Florida, North Carolina, and Tennessee.[6] It has also been replicated in educational settings as disparate as community colleges and an elite law school (where the outcome is course grades, not test scores).[7] Coupled with positive impacts on intermediate outcomes such as student attendance and suspensions, the literature suggests that the effects of race match on test scores are useful in predicting long-term outcomes of interest.[8]

RACE MATCH IN CHARTER SCHOOLS

This study's most original contribution is the merging of previously distinct literatures and policy debates surrounding charter school effectiveness on the one hand and the racial representativeness of the teaching force on the other.[9] Though previous research on race-match effects has either excluded charters or implicitly lumped them with traditional schools in one "public school" category, there are a number of reasons that race match and its effects might vary between the sectors. For example, research suggests that some "traditional" school inputs known to boost performance in traditional public schools— such as class size, per pupil expenditures, and teacher qualifications—are less predictive

of achievement in charter settings.[10] This implies more generally that the educational processes in charters are systematically different from those in traditional public schools.

Moreover, some of those differences may play into how and why having a same-race teacher matters for achievement. For example, so-called "no excuses" charter schools prominently feature a culture of high expectations.[11] Studies have shown that black teachers have significantly higher expectations for black students than do white teachers and that high expectations significantly improve college completion rates. That said, we don't know exactly how school culture, teacher race, and high expectations interact in the charter sector and whether one more of these factors play a greater role there than in the traditional public school sector.[12] More generally, race-match effects in charter schools may also be muted (or heightened) by contextual differences, such as teachers' levels of experience or training or school governance.

CHARTER SCHOOLS IN NORTH CAROLINA

Since our data are from North Carolina, we now turn to the somewhat tumultuous history of charter schools in that state. Half a century ago, to put it bluntly, the proliferation of public school choice programs and private schools in the Tar Heel State provided a way for white families to avoid court-ordered school integration. And there is some concern that the current charter school movement similarly facilitates racial segregation, although North Carolina's 1996 bipartisan charter legislation sought to address that.[13] That law explicitly banned racial discrimination in admissions and set the goal of each school's student body "reasonably reflecting" the racial and ethnic mix of the community in which it is located within one year of opening.[14]

> "...[R]ace-match effects in charter schools may also be muted (or heightened) by contextual differences..."

Charter schools in North Carolina are subject to the same end-of-grade testing requirements as traditional schools, as well as the same health, safety, and disciplinary policies. However, like charter schools elsewhere, they also have greater autonomy in key aspects of their operation, including teacher personnel decisions. Of particular relevance to the current study, North Carolina requires that only half the teachers in charter schools be certified.[15] Given racial gaps in passage rates on teacher certification tests, this relaxed rule might contribute to sector differences in the racial representation of the teaching force.

Against this backdrop, black students were initially overrepresented in North Carolina's charter sector, though this trend has recently reversed. Today, black students are evenly represented in North Carolina charters, while white students are actually overrepresented, unlike the pattern in charter schools in other states.[16] Still, the goal of racial integration has not yet been realized in the Tar Heel State, as the majority of charter schools are either less than one-fifth or more than four-fifths white, while traditional schools are more racially integrated.[17] (Note, though, that integrated schools can still lack classroom-level integration, a point we'll return to later.)

In terms of generating achievement growth, charter schools in North Carolina tend to perform about the same as, or a bit worse than, comparable traditional schools. That said, individual charter schools tend to improve with age and more recently created charters tend to be more effective than older ones.[18]

All of the above reinforces the need to examine how race-match effects vary by school composition and the importance of making within-school comparisons.

NORTH CAROLINA DEMOGRAPHICS

North Carolina is a large and diverse state, whether one looks at its socioeconomic composition, its demographics, or its topography.[19] While its student body is slightly poorer and more racially diverse than the United States as a whole, the state's public school system generally resembles those of many other large states. Moreover, results of education studies in North Carolina tend to align with those using nationally representative data, suggesting that results are often generalizable outside of the Tar Heel State.[20] One important distinction, however, is that in many states charter schools are clumped in urban centers, while in North Carolina they are located throughout the state, including rural areas (see the map of state charter schools in *Appendix A*, Figure A-1).

Still, because of the state's checkered racial history and atypical charter population, we urge caution in generalizing the results of the current study beyond North Carolina.

Methodology

DATA & METHODS

The study uses administrative data from North Carolina's Department of Public Instruction via the North Carolina Education Research Data Center.[21] We analyze data from academic years 2006–07 through 2012–13, as this is the period when student-teacher classroom assignments can be reliably identified via course membership files in both traditional public schools and public charter schools.[22] (Henceforth, years are referred to by the spring of the academic year, so 2007 refers to the 2006–07 academic year.)

The data cover all public school students in the state, traditional and charter, and include basic demographic information (e.g., race and gender) on students and teachers, end-of-grade test scores in math and English language arts (ELA) for grades 3–5, and basic school-level information such as total enrollment, geographic locale (i.e., urban, suburban, town, or rural), and demographics of the student body. Because tests are administered in grades 3–5, which are mostly self-contained classrooms, the report focuses on self-contained classroom teachers as the teacher of record. When students did not have a self-contained classroom and instead had multiple subject-specific teachers, math and ELA teachers are identified separately.

The longitudinal data span seven years, which allows us to make within-student comparisons and compute growth in achievement from year to year. Thus, the unit of analysis is the student-year and we observe about 1.8 million complete cases (student-years in which all relevant data are observed, which include end-of-grade test score, student race, teacher race, and school and teacher linkages). End-of-grade test scores are standardized by grade, year, and subject, enabling cross-year comparisons.

Unlike Thomas Dee's seminal study of student-teacher race match, which included experimentally induced random assignment of students and teachers to classrooms in Project STAR, the majority of public schools in North Carolina do not randomly assign students and teachers to classrooms.[23] This means that a naïve comparison of the outcomes of students who do, and do not, have a same-race teacher will necessarily conflate any benefits of having a same-race teacher with the unobservable characteristics that might jointly influence both academic achievement and the likelihood of having a same-race teacher. Because schools vary in the share of black teachers on staff and students are not randomly assigned to schools, students are always compared to others in the same grade who attend the same school in the same year. Still, there are likely systematic differences in how classroom assignments are made between students

in a given school. Accordingly, our methods represent best efforts to control for such confounding factors using a variety of quasi-experimental techniques. Our preferred method is to adjust for the student's lagged achievement (i.e., test score in the previous year) because there is compelling evidence that, conditional on prior performance, classroom assignments are approximately random.[24]

The intuition and details of this approach are further explained in *Appendix B*.

SAMPLE

To get acquainted with the students and schools in this analysis, it is worthwhile to examine the characteristics of the North Carolina sample. Several notable differences and similarities in the background characteristics of different students and schools emerge.

First, there is substantial variation in socioeconomic integration across school types, although there is little difference in the racial composition of the sectors (Figure 1). On average, charter students have far fewer classmates who are qualified for free and reduced-price lunch (FRL) (28 percent) than do traditional public school students (53 percent), reflecting how the charter population in North Carolina has become more affluent in recent years.

Figure 1. On average, the share of black students across sectors is about the same, but charter schools have a much lower share of FRL-qualified students (28 percent) than do traditional public schools (53 percent).
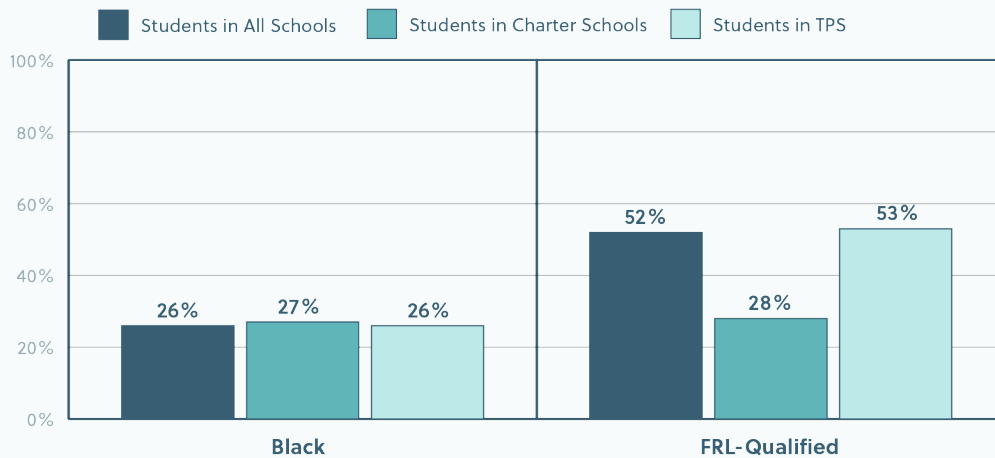
Note: Figure 1 is constructed using data from *Appendix A*, Table A-1.

Next, let's look at the differences in classroom composition between sectors (Figure 2). We see that white students in charter schools have, on average, 40 percent *fewer* black classmates than do their white counterparts in traditional public schools. Black charter school students, on the other hand, have 30 percent *more* black classmates than do their black counterparts in district-operated public schools.

As Figure 2 shows, both white and black students in charter schools have more socioeconomically advantaged peers than do their same-race counterparts in traditional public schools, an unusual pattern that reflects North Carolina's changing charter school population (see *Section II. Background*).[25] Specifically, compared to their white peers in traditional public schools, white students in charter schools have 70 percent fewer classmates receiving FRL; the figure for black students is 12 percent. Still, the racial gap is striking—and larger—in charters: Black students in charter schools have 77 percent more classmates receiving FRL than do their white charter school peers, while the gap in traditional public schools is less than half that (33 percent).

Figure 2. On average, white students have more black and FRL-qualified classmates in traditional public schools than in charters, while black students have more black classmates in charters and more FRL-qualified classmates in traditional public schools.
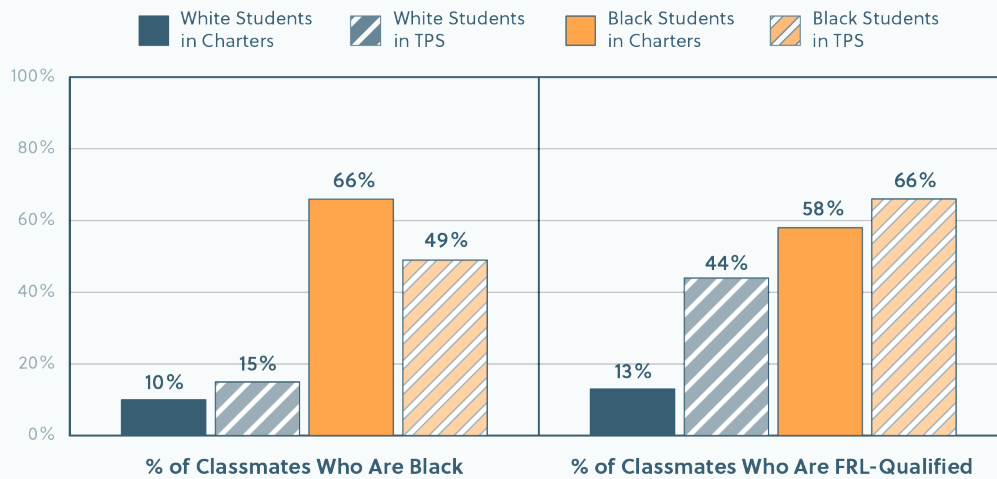
Note: Figure 2 is constructed using data from *Appendix A*, Table A-2.

Interestingly and unusually, as shown in Figure 3, there are no large racial or sectoral differences in geographic locale, while charters in many states are almost exclusively urban.

Figure 3. Twenty-nine percent of students attend urban schools, and there are only small differences across students of different races and in different school sectors.
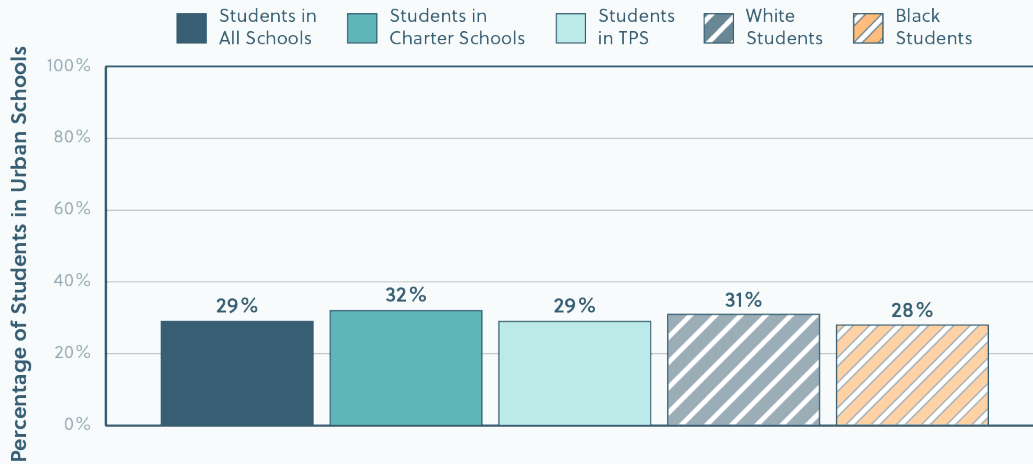
Note: Figure 3 is constructed using data from *Appendix A*, Table A-1.

Finally, although there are only small differences in academic achievement across school sectors in North Carolina, the black-white achievement gap in the state is large, as it is in most states. During the study period, the latter gap was about 75 percent of a standard deviation (SD) in math (Figure 4).

Figure 4. On average, white students score more than 75 percent of a math-score standard deviation higher than black students, and average math scores are slightly higher in charter schools than in traditional public schools, though this difference is not statistically significant.
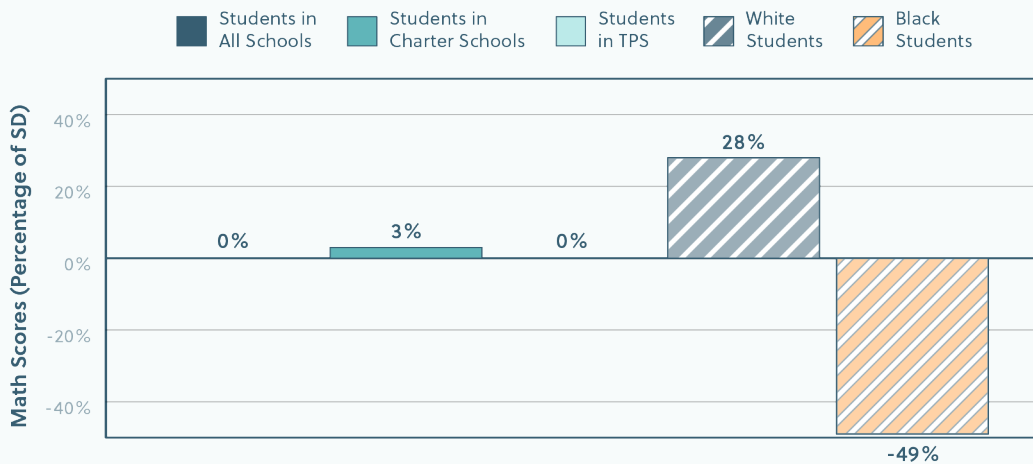
Note: Math scores for grades 3–5 are standardized by grade and year to have mean zero and a standard deviation of one. Figure 4 is constructed using data from *Appendix A*, Table A-1.

Findings

HOW COMMON IS STUDENT-TEACHER RACE MATCH IN CHARTER AND TRADITIONAL PUBLIC SCHOOLS?

KEY FINDING 1: Traditional public schools and charter schools serve the same proportion of black students, but charter schools have about 35 percent more black teachers.

Figure 5 plots the black share of public school enrollments and teachers, separately by sector, in North Carolina since 2007. In 2013, our last year of data, the student population was about 25 percent black, and black students were evenly represented in charter and traditional public schools. Black students were overrepresented in earlier years, though their proportion has fallen as students from other racial and ethnic groups have entered charter schools.

Figure 5. While previously overrepresented in charter schools, as of 2013, black students are evenly represented in traditional and charter schools, while black teachers are more likely to teach in the latter.
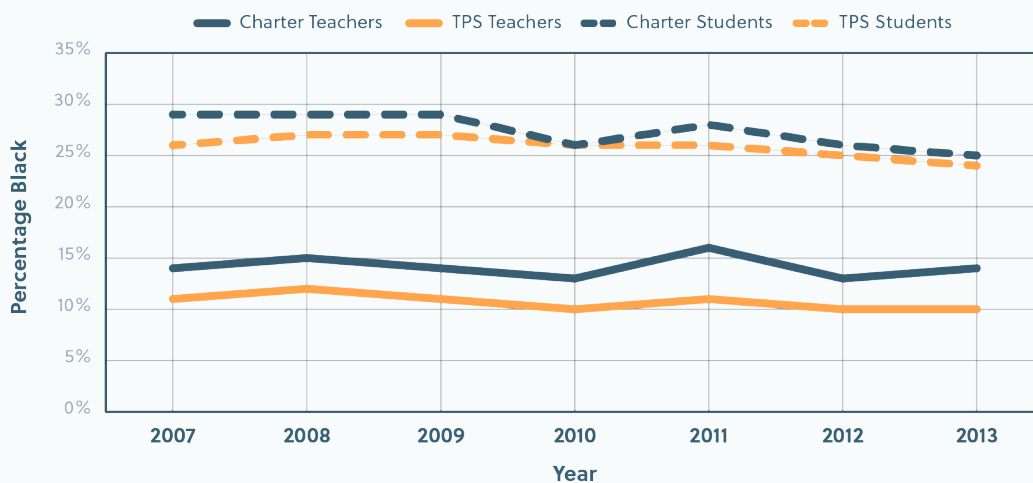
Black teachers, on the other hand, are significantly more likely to teach in charter schools than in traditional public schools. These numbers have been fairly constant over the past ten years. Even in charter schools, however, black educators constitute just 14 percent of the teaching force. These numbers are fairly similar to the country as a whole, where black educators constitute 12 and 6 percent of the charter and traditional public school teaching force, respectively.[26] Still, the population of North Carolina is 22 percent black, meaning not only does the racial makeup of the teaching force not reflect that of the student population, but also black teachers are underrepresented among the population as a whole. [27, 28]

Although black students are approximately evenly represented in charter and traditional public schools (Figure 5), there is a large gap in access to same-race teachers when looking at both school sectors combined: 91 percent of white students have a white teacher, while only 22 percent of black students have a black teacher (Figure 6). This is due both to the underrepresentation of black adults in teaching and to racial sorting among teachers whereby whites are more likely to teach in predominantly white schools and vice versa for blacks.

Figure 6. On average, white students are almost four times more likely than black students to have a same-race teacher.
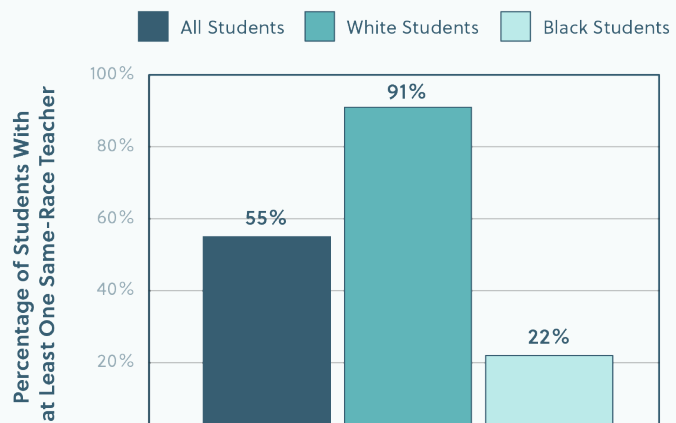
Note: Figure 6 is constructed using data from *Appendix A*, Table A-1.

KEY FINDING 2: **Black students in charter schools are more than 50 percent (13 percentage points) more likely to have a black teacher than their traditional public school counterparts, but white students are equally likely to have a white teacher across the two sectors.**

Separating the sample by race and sector allows several interesting differences to emerge.[29] First, relative to their black peers in traditional public schools, black charter students are significantly more likely to have same-race teachers (Figure 7). Specifically, 35 percent of black charter school students have a black teacher, compared to 22 percent of black students in traditional public schools. This equates to a more than 50 percent jump in the likelihood of having a same-race teacher for a hypothetical black student moving to a charter school, which is likely due to the higher share of black teachers in charters than in traditional public schools (Figure 5).[30] At the same time, around 90 percent of white students in both sectors have at least one white teacher.

One might expect that the higher degree of race match is due to charters being clustered in urban areas. But that is not the case in North Carolina. In fact, we witness an increased probability of black students having a black teacher in charter schools even when looking *only* within urban areas. Specifically, black students in urban charters have a 29 percent chance of having a same-race teacher, compared to a 21 percent chance of black students in urban traditional public schools (not shown).[31]

Figure 7. Relative to their black peers in traditional public schools, black students in charter schools are significantly more likely to have same-race teachers.
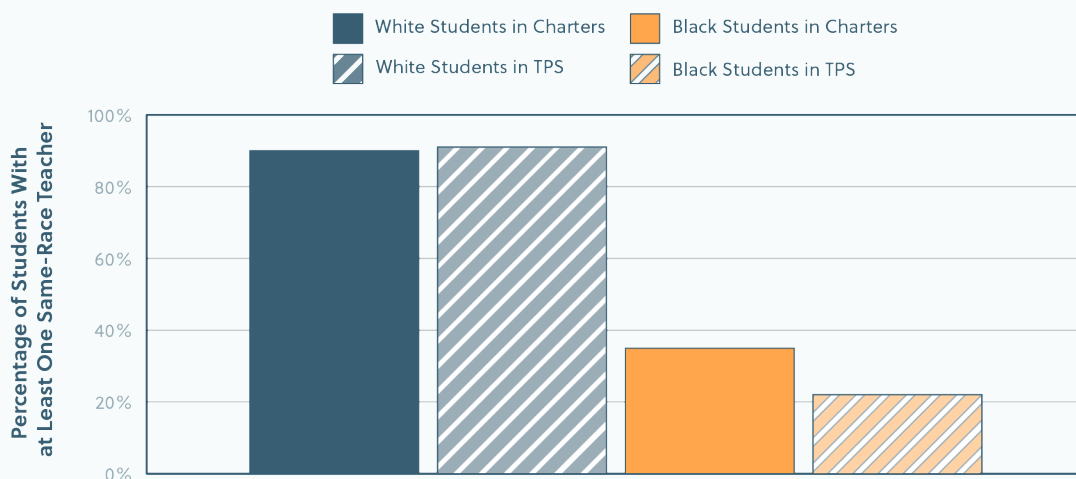
Note: Figure 7 is constructed using data from *Appendix A*, Table A-2.

EFFECTS OF STUDENT-TEACHER RACE MATCH IN CHARTER AND TRADITIONAL PUBLIC SCHOOLS

KEY FINDING 3: Race-match effects are nearly twice as large in the charter school sector as in traditional public schools, though these differences are statistically insignificant, likely due to small sample sizes.

Next, we examine the impact of having a same-race teacher across all public schools, then see whether it differs between the two sectors.

Figure 8 shows the effect of having a same-race teacher on math scores across all public schools. It is almost 2 percent of a test-score standard deviation (SD) and is strongly statistically significant.[32] To put that figure into perspective, consider that it is about the same as the effect of three student absences, ten teacher absences, or a 13 percent of a standard deviation improvement in teacher quality.[33] Effects on ELA scores are quite small and statistically indistinguishable, so the remainder of the report focuses on math scores.[34] (The precise estimates and standard errors for both math and ELA are reported in *Appendix A*, Table A-3.)

Of course, lumping together charters and traditional public schools might mask important

Figure 8. Overall, same-race teachers boost math performance by almost 2 percent of a SD, but this effect is larger in charter schools than in traditional public schools.

Legend: ■ All Schools ■ Charter Schools ■ TPS

Y-axis: Effect of Same-Race Teachers on Math Scores (Percentage of SD)

- All Schools: 1.8%
- Charter Schools: 3.0%
- TPS: 1.6%
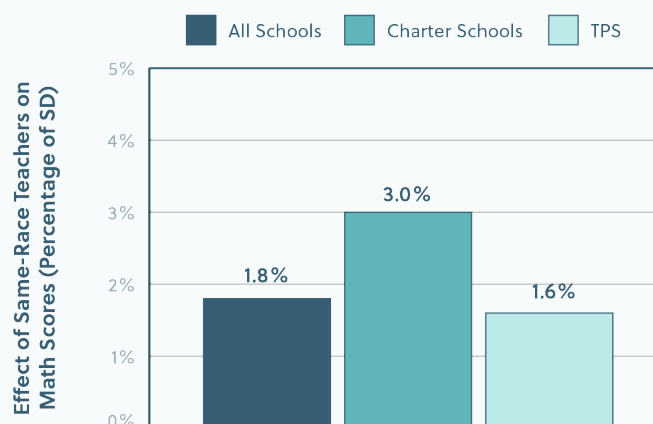
Note: Figure 8 is constructed using data from *Appendix A*, Table A-3. All three effects are statistically significantly different from zero. However, the difference between traditional public schools and charters is not itself statistically significant, likely due to the relatively small sample of charter school students. All estimates are the result of the basic lag-score model that also conditions on school-by-grade fixed effects, classroom composition, and student sociodemographic characteristics.

differences between sectors in how much having a same-race teacher matters.[35] Moving to the differential effects between the two, we see a striking sectoral difference in the impact of having a same-race teacher on math scores (Figure 8). The effect in charter schools is 3.0 percent of a SD, almost twice that found in traditional public schools (1.6 percent of a SD). This is a meaningfully large difference, even though the difference between sectors is not statistically significant at traditional confidence levels, which is likely due to the relatively small number of charter school students: The charter estimates are based on only 30,000 student-year observations, compared to more than 1 million observations for the traditional public school sector.[36]

KEY FINDING 4: In charter schools, race-match effects are twice as large for nonwhite as for white students, while no such difference exists in traditional public schools.

Next, we examine whether the race-match effects in charter schools and traditional public schools vary by student race.

Past research generally finds that student-teacher race-match effects are more pronounced among historically underrepresented groups such as blacks and Hispanics.[37] Accordingly, we now investigate whether the race-match effect in North Carolina varies by student race and ethnicity. For purposes of this analysis, all nonwhite students are grouped together to maximize statistical power, as the sample size for any one racial group is relatively small in the charter sector.[38]

Results are shown in Figure 9.[39] The second pair of bars compares the estimated race-match effect for white and nonwhite students in traditional public schools. The difference is indistinguishable from zero in terms of both statistical and practical significance.

Things look very different in the charter sector, where the difference is large in magnitude but imprecisely estimated due to the relatively small sample sizes. The race-match effect is more than twice as large for nonwhite students as for white students, which, even with the imprecision, is large enough to suggest practical importance. In short, nonwhite students get a bump of 4 percent of a standard deviation when assigned to a same-race teacher (Figure 9), which we know happens more often in charter schools than in traditional public schools (Figure 7). This suggests one reason that some charters might be relatively more effective than traditional public schools in serving historically disadvantaged groups.[40]

Figure 9. In charter schools, the effect of having a same-race teacher on math scores is twice as large for nonwhite as for white students, but no such difference is found in traditional public schools.
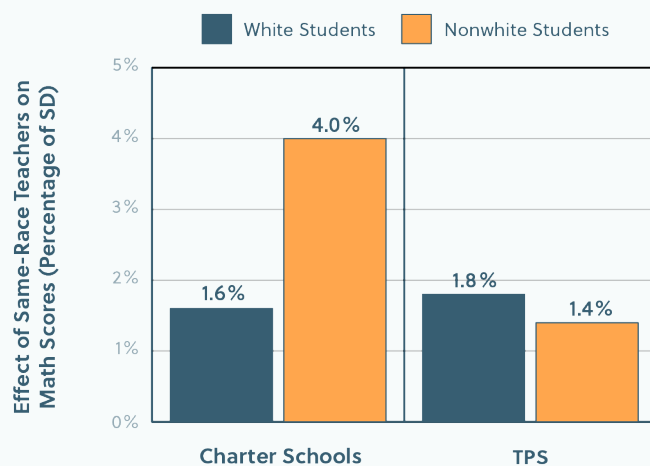
Note: Figure 9 is constructed using data from *Appendix A*, Table A-4. The gap between white and nonwhite students in traditional public schools is not statistically significant.

KEY FINDING 5: Race-match effects are relatively constant across school locales, enrollments, and compositions.

We have thus far documented positive, significant effects of student-teacher race match on students' math achievement in both traditional public schools and charter schools, effects that tend to be larger in the latter. This raises the question of whether race-match effects vary along other dimensions of school type, such as locale, size, and racial composition, and whether such factors can explain the stronger effects seen in charter schools.

In other words, when the sample is restricted to charter schools and traditional public schools of the same size that serve similar student populations or are located in similar areas, do we still see larger race-match effects in charter schools? The answer is a resounding yes, as shown in Figure 10, which investigates each of these possibilities by estimating the baseline model separately by school type.[41]

Let's look first at school composition (Figure 10). We restrict the sample to schools whose enrollments are less than 20 percent white and more than 80 percent white, respectively.[42] The first two sets of bars show remarkably little variation in race-match effects across schools of different racial compositions: The effects in traditional public schools—approximately 1 percent of a standard deviation—are smaller than in charter schools, at about 3 percent of a standard deviation. Note that these estimates are similar to the effects based on the full sample of schools. This result suggests that the larger charter effects are not driven by sectoral differences in the demographics of the student body.

Figure 10. Race-match effects exist in both charter schools and traditional public schools, though they're larger in charters, regardless of school demographics, locale, or size.
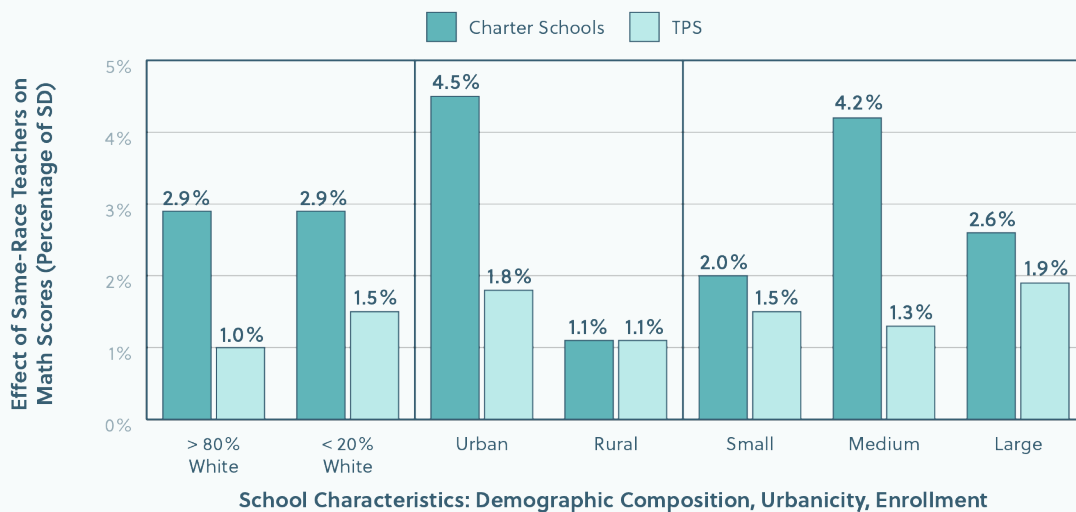
Note: Figure 10 is constructed using data from *Appendix A*, Table A-6. All of the traditional public school estimates are statistically significantly different from zero. For charters, only the urban locale and medium school size estimates are statistically significantly different from zero. School size equates to the largest third, the middle third, and the smallest third by student enrollment.

Figure 10 also describes the race-match effect in different geographic settings, as the samples are restricted to schools in urban and rural areas.[43] Among urban schools, the race-match effect is more than twice as large in charters (4.5 percent of a standard deviation) as in traditional public schools (1.8 percent). These impacts are slightly larger than those observed in the full sample (Figure 8) but are offset by smaller effects in rural schools in both sectors, where the effects are nearly identical (1.1 percent). This is the only subsample in which the charter race-match effect is not notably larger than the race-match effect in traditional public schools.

We also observe little variation by school size when splitting the sample into three evenly sized groups (Figure 10). Effects in traditional public schools range from 1.3 percent to 1.9 percent of a standard deviation while effects in charter schools range from 2.0 percent to 4.2 percent of a standard deviation for differently-sized schools. For schools of all sizes, the effect remains bigger in charters than in traditional public schools.

In sum, Figure 10 reaffirms the basic finding that race-match effects are larger in charter schools than in traditional public schools, regardless of where those schools are located and what type of population they serve.

Policy Implications

To summarize, our results show that, while white students are about equally likely to have a white teacher in either traditional public schools or charter schools, black students in charters are more than 50 percent more likely to have a same-race teacher than their black counterparts in traditional public schools (even when restricting the comparison to schools in urban areas). Student-teacher race match also improves math performance across all public elementary schools, which is consistent with similar research conducted elsewhere. In disaggregating results by sector, however, we find that the impact of having a same-race teacher is twice as large in charter schools as in traditional public schools, though these differences are statistically insignificant, likely due to small sample sizes. Moreover, within charter schools, the effect of having a same-race teacher is about twice as large for nonwhite students as for white students. These results do not vary by school locale, enrollment size, or racial makeup of the student body.

STUDENT-TEACHER RACE MATCH IN CHARTER SCHOOLS

Since the effects of having a same-race teacher are stronger in charter schools than in traditional public schools—and stronger still for nonwhite students—it's encouraging that the charter sector has more of these matches between black students and teachers, due largely to having more black teachers in the first place. This is clearly an overlooked dimension of charter effectiveness.

One reason that charters may have more black teachers is that they are freer to hire nontraditional candidates, including, in some states (like North Carolina), individuals who are not certified. This is in part because passage rates on licensing exams—often a requirement for teachers to attain certification—are lower on average for teacher candidates who are black, which may be needlessly excluding some of them from the profession.[44] This poses potential tradeoffs for charter leaders, who must balance the benefits of hiring a diverse teaching faculty against the potential downsides of lowering or eliminating certification standards. Still, on average, the benefits of a more diverse teaching force are likely to outweigh any costs: Overall, the evidence on the value of teacher certification is decidedly mixed, and, in charter schools, other studies find that certification is *negatively* correlated with achievement gains.[45]

> Still, on average, the benefits of a more diverse teaching force are likely to outweigh any costs...

What remains to be understood is why student-teacher race matches are more impactful in charter schools than in traditional schools. Perhaps there's a compounding effect in some charters with a "high expectations" culture and a high share of minority teachers, who may also have high expectations of same-race students. Or perhaps it is something about the way that charter schools are run that enables teachers of color to have an especially powerful impact. For example, charter schools serving many black students, especially those headed by black principals, may focus more on teaching the "hidden curricula" such as self-esteem, pride in black racial identity, and the political and social reasons for educational attainment that are unique to black students.[46] Again, the larger point is that the flexibility in hiring likely allows charters to hire teachers who fit with, and amplify, the school's mission, and such teachers may have a special impact.

Learning more about these impacts is an area ripe for future research. In the meantime, traditional public schools might seek to emulate their charter school peers when it comes to boosting the number of teachers of color they hire, though there remains room for improving teacher diversity (not to mention academic achievement) in both sectors.

> ...[T]here remains room for improving teacher diversity... in both sectors.

Appendix A:
Additional Tables & Figures

Table A-1. Summary Statistics of Student-Years by Race and School Type (2007–13)

	School Type			Student Demographics	
	All (1)	**Charter** (2)	**TPS** (3)	**White** (4)	**Black** (5)
Math Score (Standardized)	0.003	0.030***	0.003	0.282***	-0.487
	(0.987)	(0.957)	(0.988)	(0.928)	(0.907)
Reading Score (Standardized)	0.008	0.185***	0.003	0.305***	-0.429
	(0.987)	(0.952)	(0.987)	(0.917)	(0.918)
Student Race					
White	0.54	0.62***	0.53	1.00	0.00
Black	0.26	0.27***	0.26	0.00	1.00
Hispanic	0.13	0.05***	0.13	0.00	0.00
Asian	0.03	0.02***	0.03	0.00	0.00
Native American	0.014	0.008***	0.014	0.00	0.00
Multi-Racial	0.04	0.03***	0.04	0.00	0.00
Same-Race Teacher	0.55	0.65***	0.55	0.91***	0.22
Charter School	0.03	1.00	0.00	0.03***	0.03
Class Size	20.88	21.28	20.87	21.24***	20.28
	(5.38)	(8.99)	(5.18)	(5.38)	(5.20)
Percentage Black (Classmates)	25.74	26.97***	25.71	14.69***	49.08
	(24.53)	(32.51)	(24.26)	(16.13)	(25.42)
Percentage FRL-Qualified (Classmates)	52.28	27.74***	53.00	42.93***	65.38
	(26.75)	(33.14)	(26.20)	(24.07)	(24.61)

Note: These means correspond to Figures 1, 3, 4, and 6 of the main text. Unit of observation is student-subject-years. Sample contains student-subject-years of self-contained, ELA, and math classrooms for grades 3–5. Standard deviations in parentheses; *** p<0.01, ** p<0.05, * p<0.1 for t-tests in difference in means between columns 2 and 3, and between columns 4 and 5.

Table A-1. Summary Statistics of Student-Years by Race and School Type (2007–13) (Cont'd)

	School Type			Student Demographics	
	All (1)	Charter (2)	TPS (3)	White (4)	Black (5)
School Type					
Urban	0.29	0.32***	0.29	0.31***	0.28
Suburban	0.13	0.10***	0.13	0.14***	0.12
Town	0.12	0.16***	0.12	0.12***	0.12
Rural	0.41	0.38***	0.41	0.39***	0.43
Observations	4,312,615	122,748	4,189,867	2,308,306	1,115,063

Note: These means correspond to Figures 1, 3, 4, and 6 of the main text. Unit of observation is student-subject-years. Sample contains student-subject-years of self-contained, ELA, and math classrooms for grades 3–5. Standard deviations in parentheses; *** p<0.01, ** p<0.05, * p<0.1 for t-tests in difference in means between columns 2 and 3, and between columns 4 and 5.

Table A-2. Summary of Student Statistics by Race and Sector (2007–13)

	White Students		Black Students	
	Charter (1)	TPS (2)	Charter (3)	TPS (4)
Math Score (Standardized)	0.27***	0.28	-0.52***	-0.49
	(0.88)	(0.93)	(0.90)	(0.91)
Reading Score (Standardized)	0.44***	0.30	-0.38***	-0.43
	(0.86)	(0.92)	(0.91)	(0.92)
Male Teacher	0.09***	0.08	0.15***	0.10
Same-Race Teacher	0.90***	0.91	0.35***	0.22
Class Size	21.68***	21.23	20.57***	20.28
	(9.57)	(5.17)	(7.22)	(5.13)
Percentage Black (Classmates)	9.91***	14.85	66.16***	48.55
	(13.19)	(16.20)	(31.39)	(25.03)
Percentage FRL-Qualified (Classmates)	13.38***	43.93	58.00***	65.60
	(19.93)	(23.55)	(34.82)	(24.20)

Note: These means correspond to Figures 2 and 7 of the main text. Each column reports means of student-subject-years. Standard deviations in parentheses; *** p<0.01, ** p<0.05, * p<0.1 for t-tests in difference in means between columns 1 and 2, and between columns 3 and 4.

Table A-2. Summary of Student Statistics by Race and Sector (2007–13) (Cont'd)

	White Students		Black Students	
	Charter (1)	**TPS (2)**	**Charter (3)**	**TPS (4)**
School Type				
Urban	0.35***	0.31	0.25***	0.28
Suburban	0.11**	0.14	0.07***	0.12
Town	0.15***	0.12	0.17***	0.12
Rural	0.33***	0.39	0.49***	0.43
Observations	75,731	2,232,575	33,092	1,081,971

Note: These means correspond to Figures 2 and 7 of the main text. Each column reports means of student-subject-years. Standard deviations in parentheses; *** p<0.01, ** p<0.05, * p<0.1 for t-tests in difference in means between columns 1 and 2, and between columns 3 and 4.

Table A-3. Effects of Same-Race Teachers on Achievement (2007–13)

	Model 1	**Model 2**	**Model 3**
Effects on ELA Scores	0.003	-0.001	0.004
	(0.002)	(0.003)	(0.002)*
Effects on Math Scores	0.018	0.007	0.008
	(0.003)***	(0.003)***	(0.002)***
Effects in TPS (ELA)	0.003	-0.001	0.004
	(0.002)	(0.003)	(0.002)*
N	1,044,009	1,058,928	1,757,556
Effects in Charters (ELA)	0.029	0.017	0.042
	(0.018)	(0.022)	(0.024)*
N	29,482	30,426	43,513
Effects in TPS (Math)	0.016	0.006	0.006
	(0.003)***	(0.003)**	(0.002)***
N	1,049,912	1,063,593	1,767,447
Effects in Charters (Math)	0.030	0.027	0.027
	(0.015)**	(0.016)*	(0.019)
N	30,180	31,194	44,140
Student and Teacher Controls	Yes	Yes	No

Note: These regression results correspond to Figure 8 of the main text. Standard errors clustered at the school level in parentheses. Test scores standardized to have mean 0 and standard deviation 1. *** p<0.01, ** p<0.05, * p<0.1.

Table A-3. Effects of Same-Race Teachers on Achievement (2007–13) (Cont'd)

	Model 1	Model 2	Model 3
Classroom Controls	Yes	No	No
Student Fixed Effects (FE)	No	No	Yes
Classroom FE	No	Yes	Yes
School-Grade-Year FE	Yes	No	No
N (Full Sample)	1,073,593	1,089,510	1,812,196

Note: These regression results correspond to Figure 8 of the main text. Standard errors clustered at the school level in parentheses. Test scores standardized to have mean 0 and standard deviation 1. *** p<0.01, ** p<0.05, * p<0.1.

Table A-4. Heterogeneity by White/Nonwhite (2007–13)

	School Type	
	Charter	**TPS**
Same-Race Teacher	0.016	0.018
	(0.029)	(0.005)***
Same-Race x Nonwhite Student	0.024	-0.004
	(0.044)	(0.008)

Note: This table reports race-match effects on standardized math scores, from the baseline lag-score model, that correspond to Figure 9 of the main text. Standard errors clustered at the school level in parentheses. Test scores standardized to have mean 0 and standard deviation 1.

Table A-5. Heterogeneity in Effects of Student-Teacher Race Match on Math Achievement (2007–13)

PANEL A: ALL SCHOOLS

Students	Teachers			
	White	Black	Hispanic	Asian
White	0.000	-0.025	-0.033	0.022
	(reference)	(0.006)***	(0.015)**	(0.016)
Black	-0.118	-0.108	-0.123	-0.104
	(0.002)***	(0.005)***	(0.017)***	(0.025)***
Hispanic	-0.037	-0.035	-0.035	0.011
	(0.002)***	(0.006)***	(0.018)*	(0.029)
Asian	0.118	0.106	0.177	0.133
	(0.004)***	(0.011)***	(0.031)***	(0.026)***

Note: Each panel reports the full set of 15 mutually exclusive teacher –student race pairs, with white-white serving as the omitted reference group. The highlighted diagonal elements reflect race-matches. Estimates are from the baseline lag-score model that conditions on student and classroom controls, school-by-grade fixed effects, lagged achievement, and year indicators. Standard errors clustered at the school level in parentheses. Test scores standardized to have mean 0 and standard deviation 1. *** p<0.01, ** p<0.05, * p<0.1.

PANEL B: TRADITIONAL PUBLIC SCHOOLS

Students	Teachers			
	White	Black	Hispanic	Asian
White	0.000	-0.026	-0.032	0.021
	(reference)	(0.006)***	(0.015)**	(0.016)
Black	-0.117	-0.111	-0.126	-0.103
	(0.002)***	(0.005)***	(0.016)***	(0.026)***
Hispanic	-0.037	-0.036	-0.035	0.010
	(0.002)***	(0.006)***	(0.018)*	(0.031)
Asian	0.116	0.105	0.177	0.128
	(0.004)***	(0.012)***	(0.032)***	(0.027)***

Note: Each panel reports the full set of 15 mutually exclusive teacher –student race pairs, with white-white serving as the omitted reference group. The highlighted diagonal elements reflect race-matches. Estimates are from the baseline lag-score model that conditions on student and classroom controls, school-by-grade fixed effects, lagged achievement, and year indicators. Standard errors clustered at the school level in parentheses. Test scores standardized to have mean 0 and standard deviation 1. *** p<0.01, ** p<0.05, * p<0.1.

Table A-5. Heterogeneity in Effects of Student-Teacher Race Match on Math Achievement (2007–13) (Cont'd)

PANEL C: CHARTER SCHOOLS

Students	Teachers			
	White	**Black**	**Hispanic**	**Asian**
White	0.000	0.004	-0.198	-0.027
	(reference)	(0.038)	(0.030)***	(0.137)
Black	-0.138	-0.077	-0.205	-0.070
	(0.012)***	(0.027)***	(0.172)	(0.046)
Hispanic	-0.042	-0.026	-0.066	0.070
	(0.018)**	(0.040)	(0.144)	(0.039)*
Asian	0.172	0.174	-0.051	0.225
	(0.020)***	(0.075)**	(0.214)	(0.039)***

Note: Each panel reports the full set of 15 mutually exclusive teacher –student race pairs, with white-white serving as the omitted reference group. The highlighted diagonal elements reflect race-matches. Estimates are from the baseline lag-score model that conditions on student and classroom controls, school-by-grade fixed effects, lagged achievement, and year indicators. Standard errors clustered at the school level in parentheses. Test scores standardized to have mean 0 and standard deviation 1. *** p<0.01, ** p<0.05, * p<0.1.

Table A-6. Effects of Same-Race Teachers on Achievement by School Type (2007–13)

	ELA		Math	
	Charter	**TPS**	**Charter**	**TPS**
Urban	0.015	-0.003	0.045***	0.018***
	(0.027)	(0.004)	(0.015)	(0.006)
Rural	0.080***	0.006*	0.011	0.011***
	(0.026)	(0.003)	(0.026)	(0.004)
Smallest Enrollment Tercile	0.033	0.002	0.020	0.015***
	(0.029)	(0.004)	(0.018)	(0.004)
Middle Enrollment Tercile	0.018	0.003	0.042*	0.013***
	(0.027)	(0.004)	(0.023)	(0.005)
Largest Enrollment Tercile	0.057	0.003	0.026	0.019***
	(0.037)	(0.004)	(0.051)	(0.006)

Note: This table reports race-match effects on standardized math scores, from the baseline lag-score model that correspond to Figure 10 of the main text. Each cell reports the race-match effect from a unique regression. All models are the basic lag-score value-added model that controls for observed student, teacher, and classroom characteristics, as well as school-by-grade-by-year fixed effects. Standard errors clustered at the school level in parentheses. Test scores standardized to have mean 0 and standard deviation 1. *** p<0.01, ** p<0.05, * p<0.1.

Table A-6. Effects of Same-Race Teachers on Achievement by School Type (2007–13) (Cont'd)

|	ELA		Math	
	Charter	**TPS**	**Charter**	**TPS**
School > 80% White	0.035	-0.003	0.029	0.010
	(0.048)	(0.014)	(0.036)	(0.014)
School < 20% White	0.031	0.000	0.029	0.015***
	(0.024)	(0.003)	(0.019)	(0.003)

Note: This table reports race-match effects on standardized math scores, from the baseline lag-score model that correspond to Figure 10 of the main text. Each cell reports the race-match effect from a unique regression. All models are the basic lag-score value-added model that controls for observed student, teacher, and classroom characteristics, as well as school-by-grade-by-year fixed effects. Standard errors clustered at the school level in parentheses. Test scores standardized to have mean 0 and standard deviation 1. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Figure A-1. Map of Charter Schools in North Carolina (2018)

Source: http://www.ncpublicschools.org/charterschools/schools/map.
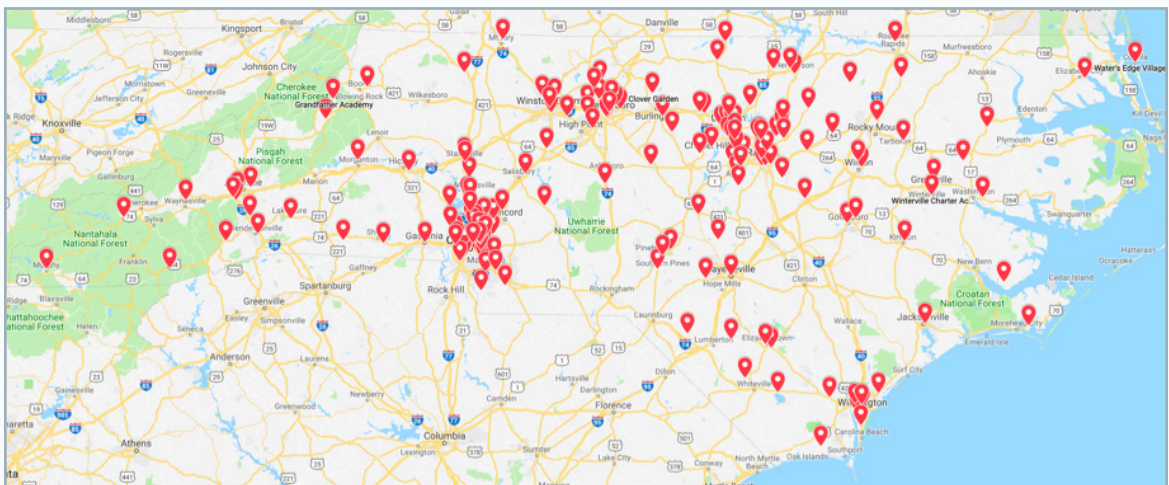
Figure A-2. Extent of Teacher Race Match by Student Race and School Type (2007–13)
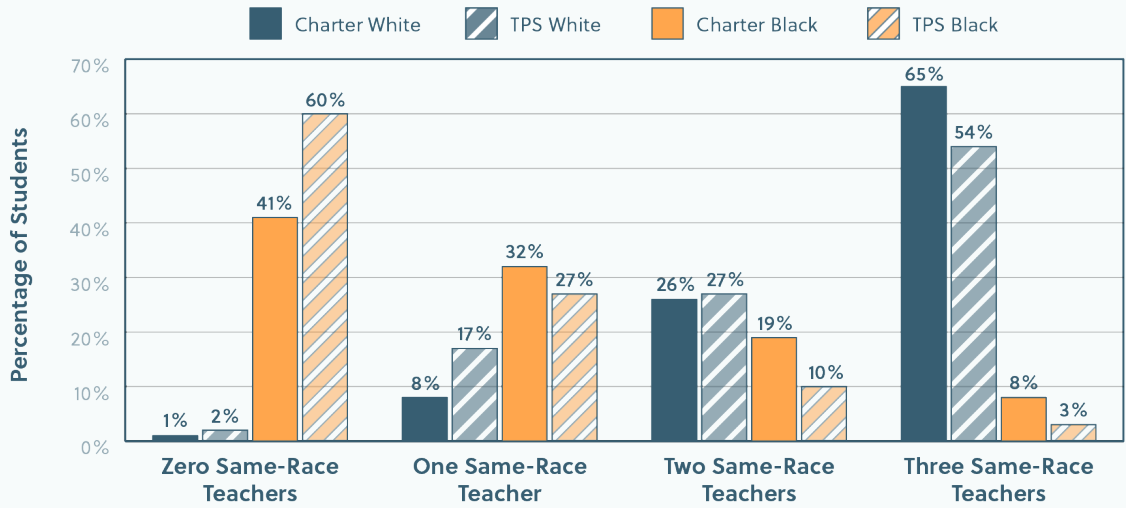
Note: Calculated using student-level sample of students who attended a public school (charter or TPS) in North Carolina for grades 3–5. Same-race counts restricted to grades 3–5.

Appendix B:
Technical Methods

OVERVIEW

Our methodology compares students to others in the same grade who attend the same school in the same year. Still, there are likely systematic differences in how classroom assignments are made in a given school. The fundamental issue is that even within a given school, grade, and year, unobserved factors might jointly predict both student achievement and the type of classroom to which a student is assigned.[47] For instance, a highly involved parent might call the principal to ask that her child be assigned to a specific teacher. That parent might also go out of her way to help her child with homework and provide stimulating extracurricular opportunities. In this scenario, it is difficult to isolate the impact of the teacher from the impact of the parent, and such positive selection will cause the estimated effect of teacher characteristics to be biased upward. Alternatively, the parent or principal might worry about a child's struggles and intentionally assign that student to a strong teacher. Again, it is difficult to isolate the effect of the teacher from the student's pre-existing struggles, and such negative selection will cause the estimated effect of teacher characteristics to be biased downward.

There are two ways that education researchers attempt to counter such problems, which fit under the broad term of "value-added modeling."[48] In each, the idea is to adjust for the unobserved factor that led to the nonrandom classroom assignment. Our preferred method is to adjust for the student's lagged achievement (i.e., test score in the previous year) because there is compelling evidence that, conditional on prior performance, classroom assignments are approximately random.[49]

Intuitively, this approach assumes that a student's performance in grade 3 is the main factor that might cause parents or schools to strategically assign the student to a grade 4 classroom. Controlling for grade 3 performance effectively "undoes" that nonrandom assignment. This leads to the basic lag-score value-added model commonly used to estimate teacher effectiveness.[50] In addition to lagged achievement, the models also control for parents' education and the free and reduced-price lunch (FRL) status of students, as well as classroom measures such as class size, percentage black, and percentage FRL. The model can also be augmented to allow the race-match effect to vary, and in what follows, it varies by school size, locale, principal race, classroom racial composition, and, in some cases, by student race.

An alternative approach utilized student fixed effects, which adjusted for innate, unobserved student characteristics fixed over time, and yielded similar results. That both approaches yielded similar results bolsters confidence that the estimated race-match effects can be considered causal.

MODELS

We attempt to isolate causal effects by controlling for selection into classrooms in two ways. In each case we condition on school-by-grade-by-year fixed effects (FE), which mean that all estimates are identified by comparing students who attend the same school, in the same grade, in the same year. The first approach is to simply control for lagged achievement, as in a standard value-added model, which previous research suggests adequately controls for sorting into classrooms.[51] Specifically, we estimate value-added models of the form

1. $A_{ijgst} = \alpha A_{i,t-1} + \beta X_{it} + \gamma C_{-i,jgst} + \delta match_{ij} + \Theta_{gst} + \varepsilon_{ijgst}$

where i, j, g, s, and t index students, teachers, grades, schools, and years, respectively; A is a standardized math or ELA end-of-grade test score; X is a vector of possibly time-varying student characteristics including sex, race, parents' education, FRL, English language learners (ELL), and Individualized Education Program (IEP); C is a vector of classroom-level variables including class size, percentage of class FRL (excluding student i), percentage of class nonwhite (excluding student i), and teacher race; match is a binary indicator equal to one if the student and teacher are the same race, and zero otherwise; Θ is a school-by-grade-by-year FE; and ε is an idiosyncratic error. We estimate equation (1) by ordinary least squares (OLS) and cluster the standard errors by school, which allows for arbitrary forms of heteroskedasticity and serial correlation within schools over time. The results are robust to clustering along other dimensions.

A few points about equation (1) merit further discussion. First, the school-grade-year FE subsumes the separate school, grade, and year FE that are normally included in a value-added model. It also makes redundant any school-level controls. The presence of these FE mean that the estimates are identified from schools that had within-grade racial variation in the student body in a given year; i.e., if all the grade 4 students in school s in year t were white, these students don't contribute to our analysis and we don't learn anything about the race-match effect in such an environment. This is an issue of external, not internal, validity that is always present when using the FE (within) estimator.

Second, the match variable indicates a specific (e.g., black-black) match and not a more general nonwhite-nonwhite match. Accordingly, δ is the parameter of interest and is interpreted as the effect, in test-score SD, of having a same-race teacher on achievement (A). Third, incorporating the lag score means that equation (1) can be estimated only for fourth and fifth graders who were in North Carolina public schools for at least two years in grades 3–5, as one year of data are lost to provide the lag. Finally, the classroom variables C and school-by-grade-by-year FE Θ can be replaced by a classroom FE, which further tightens the comparison to students of different races in the same classroom, and eliminates concerns about unobserved teacher ability and unobserved classroom factors that might be correlated with teacher race and student outcomes.

This leads to the second approach, which is a two-way FE strategy that conditions on both student and classroom FE.[52]

This approach explicitly makes within-student comparisons of a given student's performance in consecutive years, one of which she had a same-race teacher and one of which she had a different-race teacher. This is accomplished by controlling for student fixed effects. Unlike the lag-score approach described above, this approach does not make dynamic adjustments based on previous performance; it instead removes unobserved factors that are relatively fixed over time, such as innate ability and parental involvement, which might jointly influence achievement and classroom assignments. Intuitively, the student fixed-effect and lag-score approaches likely bound the true effect of having a same-race teacher, as they control for two polar-opposite types of confounding factors: those that are completely fixed over time and those that vary from year to year.[53]

Specifically, we estimate

2. $A_{ijgst} = \beta X_{it} + \delta match_{ij} + \alpha_i + \omega_{jgst} + \varepsilon_{ijgst}$

where X includes only time-varying factors such as FRL, ELL, and IEP and ω is a classroom FE. We estimate equation (2) using the two-way FE estimator proposed by Correia and once again cluster standard errors by school.[54] The interpretation of δ is the same as in equation (1), but now the match effect is identified off of students who are both (i) in racially mixed classrooms and (ii) experience both a same- and other-race teacher. Unlike the dynamic estimator in equation (1) that controls for past achievement, the two-way FE model specified in equation (1) controls for time-invariant student attributes.

Endnotes

1. Thomas S. Dee, "Teachers, Race, and Student Achievement in a Randomized Experiment," *Review of Economics and Statistics* vol. 86, no. 1 (2004): 195–210, https://www.nber.org/papers/w8432. Seth Gershenson, Cassandra Hart, Joshua Hyman, Constance Lindsay, and Nicholas W. Papageorge, "The Long-Run Impacts of Same-Race Teachers," National Bureau of Economic Research no. 25254 (2018), https://www.nber.org/papers/w25254. Stephen B. Holt and Seth Gershenson, "The Impact of Demographic Representation on Absences and Suspensions," *Policy Studies Journal* (2017), https://onlinelibrary.wiley.com/doi/full/10.1111/psj.12229. Constance A. Lindsay and Cassandra M.D. Hart, "Exposure to Same-Race Teachers and Student Disciplinary Outcomes for Black Students in North Carolina," *Educational Evaluation and Policy Analysis* vol. 39, no. 3 (2017): 485–510, https://journals.sagepub.com/doi/abs/10.3102/0162373717693109?journalCode=epaa.

2. The reason that some charters are more effective than traditional schools is another source of debate in education policy circles. See, for example, Will Dobbie and Roland G. Fryer, Jr. "Getting beneath the Veil of Effective Schools: Evidence from New York City." American Economic Journal: *Applied Economics* vol. 5, no. 4 (2013): 28–60, https://www.aeaweb.org/articles?id=10.1257/app.5.4.28.

3. These years are used because course membership files are available that link students and teachers to specific classrooms. In prior years, links must be made by imprecise exam proctorship records, and in later years, charter school course membership data are lacking.

4. Dee, 2004.

5. Gershenson et al., 2018.

6. North Carolina: Charles T. Clotfelter, Helen F. Ladd, and Joseph L. Vigdor, "How and Why do Teacher Credentials Matter for Student Achievement?" National Bureau of Economic Research no. 12828 (2007), https://www.nber.org/papers/w12828. Tennessee: Ela Joshi, Sy Doan, and Matthew G. Springer, "Student-Teacher Race Congruence: New Evidence and Insight From Tennessee," *AERA Open* (2018), https://journals.sagepub.com/doi/10.1177/2332858418817528. Florida: Anna J. Egalite, Brian Kisida, and Marcus A. Winters, "Representation in the classroom: The effect of own-race teachers on student achievement," *Economics of Education Review* vol. 45 (2015): 44–52, https://www.sciencedirect.com/science/article/abs/pii/S0272775715000084. The focus on southern states is largely due to data availability to researchers in North Carolina, Florida, and Tennessee; however, there is also some evidence in nationally representative data that race-match effects on teachers' perceptions of student behavior are concentrated in the South. Thomas S. Dee, "A Teacher like Me: Does Race, Ethnicity, or Gender Matter?," *American Economic Review* vol. 95, no. 2 (2005): 158–165, https://www.jstor.org/stable/4132809.

7.   Chris Birdsall, Seth Gershenson, and Raymond Zuniga, "The Effects of Demographic Mismatch in an Elite Professional School Setting," *Education Finance and Policy* (2018): 1–50, https://www.mitpressjournals.org/doi/abs/10.1162/edfp_a_00280. Robert W. Fairlie, Florian Hoffmann, and Philip Oreopoulos, "A Community College Instructor Like Me: Race and Ethnicity Interactions in the Classroom," National Bureau of Economic Research no. 17381 (2014), https://www.nber.org/papers/w17381.

8.   Holt and Gershenson, 2017. Lindsay and Hart, 2017.

9.   Evidence on charter schools' effectiveness is not easily summarized. There are a number of possible reasons, including differences between states in how charters are issued and held to account, differences in the quality of charter operators, and methodological differences between studies in how analysts control for selection into the schools. That said, several high-quality studies find that urban charter schools tend to outperform similar traditional public schools (TPS), and those that leverage the randomness of charter admission lotteries tend to find positive effects on test scores and college outcomes (e.g., "Urban Charter School Study: Report on 41 Regions," Center for Research on Education Outcomes (2015), http://urbancharters.stanford.edu/download/Urban%20Charter%20 School%20Study%20Report%20on%2041%20Regions.pdf. "Charter School Performance in New York," Center for Research on Education Outcomes (2017), http://credo.stanford. edu/pdfs/NY_State_report%202017%2006%2001%20FINAL.pdf.)

10.   Dobbie and Fryer, 2013.

11.   Joshua D. Angrist et al., "Inputs and impacts in charter schools: KIPP Lynn," *American Economic Review* vol. 100, no. 2 (2010): 239–43, https://economics.mit.edu/files/5465.

12.   Seth Gershenson, Stephen B. Holt, and Nicholas W. Papageorge, "Who Believes in Me? The Effect of Student–Teacher Demographic Match on Teacher Expectations," *Economics of Education Review* vol. 52 (2016): 209–224, https://www.sciencedirect.com/science/ article/abs/pii/S0272775715300959. Nicholas W. Papageorge, Seth Gershenson, and Kyung M. Kang, "Teacher Expectations Matter," National Bureau of Economics Research no. 25255 (2018), http://ftp.iza.org/dp10165.pdf.

13.   Helen F. Ladd, Charles T. Clotfelter, and John B. Holbein, "The Growing Segmentation of the Charter School Sector in North Carolina," *Education Finance and Policy* vol. 12, no. 4 (2017): 536–563, https://www.mitpressjournals.org/doi/abs/10.1162/edfp_a_00226.

14.   Ibid.

15.   "Teacher Licensure FAQ for Administrators," North Carolina State Board of Education, http://www.ncpublicschools.org/charterschools/information/ topics?role=administrators&&topic=Teacher%20Licensure.

16.   Ibid.

17.   Robert Bifulco and Helen F. Ladd, "School Choice, Racial Segregation, and Test-Score Gaps: Evidence from North Carolina's Charter School Program," *Journal of Policy Analysis and Management* vol. 26, no. 1 (2007): 31–56, https://www.jstor.org/ stable/30164083?seq=1#page_scan_tab_contents.

18.   Celeste K. Carruthers, "New schools, new students, new teachers: Evaluating the effectiveness of charter schools," *Economics of Education Review* vol. 31, no. 2 (2012): 280–292, https://www.sciencedirect.com/science/article/abs/pii/S0272775711001002.

19.   For more about our analytic sample from North Carolina, see *Sample* in *Section III. Methodology* and *Appendix A.*

20. Seth Gershenson,"Linking Teacher Quality, Student Attendance, and Student Achievement," *Education Finance and Policy* vol. 11, no. 2 (2016): 125–149, https://www.mitpressjournals.org/doi/10.1162/EDFP_a_00180.

21. Founded in 2000, the North Carolina Education Research Data Center (NCERDC) provides researchers and the broader policy community with access to data for policy-oriented research. It cleans, codes, and standardizes longitudinal data files and makes these files available to approved researchers. The center is housed in the Social Science Research Institute at Duke University and continues to process new data released by the Department of Public Instruction annually. For more on the NCERDC, see Clara Muschkin, Kara Bonneau, and Kenneth Dodge, "North Carolina Education Research Data Center Grant #200300138: Final Report to the Spencer Foundation" Duke University: Center for Child and Family Policy (2011), https://childandfamilypolicy.duke.edu/pdfs/projects/NCERDC_SpencerFoundationReport.pdf.

22. Data from earlier years can only link students to teachers via exam proctorship records, in which case the proctor is likely to be, but not definitely, the teacher. The course membership data was fully rolled out in 2007, but after 2013 the charter reporting becomes spotty.

23. Hedvig Horváth, "Classroom Assignment Policies and Implications for Teacher Value-Added Estimation," working paper (2015), https://www.dropbox.com/s/bxoccx7k1hwuif9/sorting_wp_horvath.pdf?dl=0. Jesse Rothstein, "Teacher Quality in Educational Production: Tracking, Decay, and Student Achievement," *The Quarterly Journal of Economics* vol. 125, no. 1 (2010): 175–21, https://www.nber.org/papers/w14442.

24. Raj Chetty, John N. Friedman, and Jonah E. Rockoff, "Measuring the Impacts of Teachers I: Evaluating Bias in Teacher Value-Added Estimates," *American Economic Review* vol. 104, no. 9 (2014): 2593–2632, https://www.nber.org/papers/w19423. Cassandra M. Guarino, Mark D. Reckase, and Jeffrey M. Wooldridge, " Can Value-Added Measures of Teacher Performance Be Trusted?" *Education Finance and Policy* vol. 10, no. 1 (2015): 117–156, https://files.eric.ed.gov/fulltext/ED537163.pdf. Thomas J. Kane, and Douglas O. Staiger, "Estimating Teacher Impacts on Student Achievement: An Experimental Evaluation," National Bureau of Economic Research no. 14607 (2008), https://www.nber.org/papers/w14607.

25. These demographic changes are rather unique to North Carolina: Nationally, more than one- third of charter schools enroll more than 80 percent of students who receive free and reduced-price lunch, while less than one- quarter of traditional public schools do. Dennis Epple, Richard Romano, and Ron Zimmer, "Charter Schools: A Survey of Research on Their Characteristics and Effectiveness," Elsevier: *Handbook of the Economics of Education* vol. 5 (2016): 139–208, https://www.nber.org/papers/w21256.

26. Ibid.

27. Recent population estimates based on data from the United State Census Bureau and other U.S. government agencies can be accessed at https://www.census.gov/quickfacts/fact/table/nc,US/PST045217.

28. Full set of means and standard deviations reported in *Appendix A*, Table A-1.

29. Full set of means and standard deviations reported in *Appendix A*, Table A-2.

30. That said, we cannot rule out that race match may be influenced by sectoral differences in how students are assigned to classrooms.

31. Nor is this a one-off event. *Appendix A*, Figure A-2 shows that there are significant sectoral differences in the total exposure to same-race teachers: Black students who are in a charter school for three consecutive years for grades 3–5 are 20 percent less likely than their black TPS counterparts to have zero black teachers and 5 percent more likely to have three.

32. The size of this effect is also quite similar to the magnitudes of race-match effects on math achievement recently uncovered in elementary schools in Tennessee and Florida. See Joshi et al., 2018; Egalite et al., 2015.

33. Erik A. Hanushek and Steven G. Rivkin, " Generalizations about Using Value-Added Measures of Teacher Quality," *American Economic Review* vol. 100, no. 2 (2010): 267–71, http://hanushek.stanford.edu/publications/generalizations-about-using-value-added-measures-teacher-quality. Seth Gershenson, Alison Jacknowitz, and Andrew Brannegan, "Are Student Absences Worth the Worry in U.S. Primary Schools?," E*ducation Finance and Policy* vol. 12, no. 2 (2017): 137–165, https://www.iza.org/publications/dp/9558/are-student-absences-worth-the-worry-in-us-primary-schools. Seth Gershenson, "Performance Standards and Employee Effort: Evidence From Teacher Absences" *Journal of Policy Analysis and Management* vol. 35, no. 3 (2016): 615–638, https://onlinelibrary.wiley.com/doi/abs/10.1002/pam.21910.

34. This result is consistent with previous research in North Carolina covering the period 1995–2004. Specifically, see columns 2 and 4 of Table 2 in Clotfelter et al., 2007, which are comparable to the models estimated in columns 1 and 3 of *Appendix A*, Table A-2 of the current study. That schooling inputs have a larger effect on math than on English language arts scores is also consistent with evidence on the efficacy of many educational inputs, including recent research on race-match effects, perhaps because reading skills are more likely to be developed at home. See Joshi et al., 2018; Egalite et al., 2015.

35. Indeed, a formal Chow test suggests that the education production function in charter schools is systematically different than that in traditional public schools.

36. Intuitively, the TPS effect is similar to, but slightly smaller than, the overall effect across all public schools. The reason is that the larger charter estimates pulled up the average effect in the pooled analysis. However, this "pulling up" effect is small, because charter students constitute only 3 percent of the pooled sample.

37. Dee, 2004; Joshi et al., 2018.

38. *Appendix A*, Table A-5 presents more nuanced estimates that disaggregate by race for four groups: white, black, Hispanic, and Asian. Specifically, the table reports the coefficients for fifteen unique, mutually exclusive student-teacher race pairs (omitting white-white as the sixteenth reference category). Comparing across rows of Panel A and Panel B (representing results for all schools and traditional public schools, respectively), we see that Asian students outperform white students, who outperform Hispanic students, who outperform black students, on average, regardless of the teacher. Comparing across columns within rows of Panel A, we see that overall white students with a white teacher gain about 2 percent of a SD while black students with a black teacher do about 1 percent of a SD better than black students with a white teacher, but 2 percent better than when assigned to a Hispanic teacher. Results look very different in charter schools (Panel C), however, where there is no difference between white students assigned to white and black teachers, but a huge gain (6 percent of SD) when black students have a black rather than white teacher. Asian students see a similar gain (5 percent of SD) when assigned to a same-race rather than a white teacher in charter schools. This is consistent with the dichotomous white/nonwhite results presented in the main text, which we prefer due to power concerns about small cell sizes in the appendix table, specifically for the charter school analysis, where the standard errors are large and coefficient estimates are susceptible to the influence of outliers in the smaller cells.

39. Coefficient estimates and standard errors reported in *Appendix A*, Table A-6.

40. For example, see Sarah Cohodes, "Charter Schools and the Achievement Gap," Princeton University: *The Future of Children* (2018), https://futureofchildren.princeton.edu/news/charter-schools-and-achievement-gap.

41. Coefficient estimates and standard errors reported in *Appendix A*, Table A-6.

42. These cutoffs were selected because previous research uses them to document growing racial segregation in North Carolina's charters and the majority of charter schools fall into these categories. See Ladd et al., 2017.

43. The majority of students are located in urban and rural schools, in both sectors and for both black and white students.

44. Madeline Will, "You're More Likely to Pass the Bar Than an Elementary Teacher Licensing Exam," *Education Week* (blog), February 26, 2019, http://blogs.edweek.org/edweek/teacherbeat/2019/02/aspiring_elementary_teachers_licensing_test_failure.html..

45. Will Dobbie and Roland G. Fryer, Jr., "Getting Beneath the Veil of Effective Schools: Evidence from New York City," *American Economic Journal: Applied Economics* vol. 5, no. 4 (2013): 28–60, https://www.aeaweb.org/articles?id=10.1257/app.5.4.28. Donald Boyd, Daniel Goldhaber, Hamilton Lankford, and James Wyckoff, "The Effect of Certification and Preparation on Teacher Quality," Princeton University: *The Future of Children* vol. 17, no. 1 (2007): 45–68, https://www.ncbi.nlm.nih.gov/pubmed/17407922.

46. Michèle Foster, "The Politics of Race: Through the Eyes of African-American Teachers," *Journal of Education* vol. 172, no.3 (1990): 123–141, https://journals.sagepub.com/doi/10.1177/002205749017200309.

47. Rothstein, 2010.

48. Guarino et al., 2015.

49. Chetty et al., 2014; Guarino et al., 2015; Kane and Staiger, 2008.

50. Chetty et al., 2014; Guarino et al., 2015.

51. Ibid.

52. Fairlie et al., 2014

53. Joshua D. Angrist and Jörn-Steffen Pischke, *Mostly Harmless Econometrics: An Empiricist's Companion*, Princeton University Press (2008), https://press.princeton.edu/titles/8769.html.

54. Sergio Correia, "REGHDFE: Stata module to perform linear or instrumental variable regression absorbing any number of high-dimensional fixed effects," Boston College Department of Economics: *Statistical Software Components* s457874 (2015), https://ideas.repec.org/c/boc/bocode/s457874.html.