# The Impact of Same-Race Teachers on Student Non-Test Academic Outcomes*

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**Abstract**

It is well established that students taught by same-race teachers improve their performance on exams. However, little is known about whether the positive impact extends beyond test scores to student non-test academic outcomes, which are known to predict student long-term success. Using the random assignment of teachers within the Measures of Effective Teaching (MET) project, I show that same-race teachers not only improve the test scores of Black students, but also increase the effectiveness of communication as reported by Black students. I find evidence supporting one of three potential underlying mechanisms of the communication effect. Specifically, I find that neither i) higher general communication ability of Black teachers nor ii) more teacher attention directed towards same-race students can explain this effect. Rather, my results suggest that the effect is driven by more effective communication between Black teachers and Black students, which aligns with the literature on culturally relevant pedagogy. Overall, the findings suggest that training non-minority teachers in using culturally relevant pedagogy may improve the performance of disadvantaged minority students in the short term as a complement to diversification of the teacher labor force.

**JEL codes:** I20, I21, J15

**Keywords:** Same-race teacher, Teacher-student communication, Match effects, Non-test academic outcomes

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# 1 Introduction

Disparities in cognitive and socio-emotional skills between minority and non-minority students often arise in the period of early childhood[1] and have been shown to have important long-lasting impacts on student well-being (Todd & Wolpin, 2007). One approach to diminish the preschool disadvantage is attracting more effective teachers, who may significantly improve student performance (Rockoff, 2004) and long-term outcomes (Chetty, Friedman, & Rockoff, 2014). However, as previous studies suggest, teacher effectiveness differs across contexts and depends on teacher-school matches (Jackson, 2013) and teacher-class matches (Aucejo et al., 2019; Graham, Ridder, Thiemann, & Zamarro, 2020). One particular case of matches relates to teachers sharing the same identity with students. Despite the extensive evidence on the positive effects of being matched with same-identity teachers (same-race and same-gender teachers), on student test scores[2], little is known whether the effects of same-identity teachers extend beyond test scores to other non-test academic outcomes[3]. Examining the effects of same-identity teachers on non-test academic outcomes is essential, as this type of outcome is highly related to socio-emotional skills and predicts student success in adulthood. Teachers who are more effective in enhancing non-test academic outcomes are more likely to improve long-term student outcomes than those who are only effective in improving test scores (Jackson, 2018).

This paper examines the effects of a same-race teacher[4] on one of the non-test

[1] Bond and Lang (2018) find that the black-white test gap evolution does not have a racial component in human capital acquisition, but can be explained by differences in socioeconomic characteristics from childhood. However, this finding does not exclude the possibility that future investments may mitigate the initial disadvantage.

[2] For instance, Dee (2004); Egalite, Kisida, and Winters (2015); Fairlie, Hoffmann, and Oreopoulos (2014); Joshi, Doan, and Springer (2018); Lusher, Campbell, and Carrell (2018); Penney (2017a, 2017b) have shown positive effects of same-race teachers on student test scores.

[3] There is scant evidence on the positive effects of a same-race teacher on behavioral and other non-test academic outcomes (Dee, 2005; Egalite & Kisida, 2018; Gershenson, Holt, & Papageorge, 2016; Holt & Gershenson, 2019; Lindsay & Hart, 2017)

[4] I limit my analysis to the impact of a same-race teacher and cannot examine the effects of a same-gender teacher on student performance, as most teachers in my sample are female.

academic outcomes, particularly student-teacher communication effectiveness, and explores the possible underlying explanations behind these effects. To identify the effects of a same-race teacher, I exploit the random assignment of teachers to classes within the U.S. Measures of Effective Teaching (MET) project, which enables me to address the issues related to the systematic sorting of students and teachers. I use the information on student-level perceptions of teaching practices from the Student Perception Survey (SPS) and administrative data to measure student-teacher communication effectiveness and test scores, respectively.

I find that being taught by a same-race teacher improves the performance of Black students on math test scores. However, the effects of a same-race teacher on English test scores are small and insignificant. These findings are consistent with previous findings[5] of the randomized STAR study (Dee, 2004) and more recent evidence from observational studies (Joshi et al., 2018). Beyond the effect of a same-race teacher on test scores, I find that matched Black students report more effective communication with their same-race teachers than do their unmatched schoolmates. While I do not find that teacher-student communication explains much of the effect of a same-race teacher on the test score, communication effectiveness may help to explain the long-run effects of same-race teachers documented by Gershenson, Hart, Hyman, Lindsay, and Papageorge (2018).

To understand the possible underlying explanations behind the effect of a same-race teacher on communication effectiveness, I examine the effects of a same-race teacher on separate dimensions of communication. The findings indicate that Black students report better understanding of explanations made by same-race teachers than those of White teachers. These findings suggest that the effect of a same-

[5]The evidence from previous papers on the effects of a same-race teacher is based on the Tennessee STAR project from the 1980s (Dee, 2004), which may be drastically different in terms of the school environment and administrative data from the specific school district or state; e.g., Florida (Egalite et al., 2015)

race teacher on communication may be explained by a shared cultural background and culturally aligned instructions, which are in line with the hypothesis of studies about culturally relevant pedagogy (Dee & Penner, 2017; Ladson-Billings, 1995). Additionally, I do not find evidence supporting two alternative explanations for the positive effect of a same-race teacher on communication effectiveness, including higher general communication ability of Black teachers and more teacher attention directed towards matched students. The latter suggests that gains for matched students are not at the expense of non-matched students.

This paper adds to previous studies on the impacts of same-race teachers on student perceptions and behavioral outcomes (Egalite & Kisida, 2018; Gershenson et al., 2016; Holt & Gershenson, 2019; Lindsay & Hart, 2017) and long-term outcomes (Gershenson et al., 2018) by providing direct evidence on the effects of a same-race teacher on student-teacher communication effectiveness. This finding emphasizes the importance of matching students to a same-race teacher for improving non-test academic outcomes, which may help to explain the improved long-term outcomes documented by Gershenson et al. (2018). This paper also relates to a broader strand of literature on teacher effects and match effects (Aucejo et al., 2019; Graham et al., 2020; Jackson, 2013; Wedenoja, Papay, & Kraft, 2020) by shedding light on the importance of matching minority students with a same-race teacher. Furthermore, the findings align with the hypothesis about culturally relevant pedagogy (Dee & Penner, 2017; Irvine, 1989; Ladson-Billings, 1995), according to which Black teachers are better at instructing same-race students, for instance,they often use more relevant examples, thanks to a higher degree of shared cultural background.

Overall, the findings of this paper may imply that the effects of a same-race teacher extend beyond test scores to non-test academic outcomes, which can help to explain the positive long-term effects of a same-race teacher. In particular, I show that same-race teachers improve the effectiveness of communication with Black

students. The evidence further supports that this effect is driven by the higher effectiveness of Black teachers at instructing same-race students in particular, which aligns with the literature on culturally relevant pedagogy.

The remainder of this paper is as follows. Section 2 reviews previous related literature. Section 3 describes data. Section 4 discusses identification and estimation strategies. Section 5 provides evidence of the effects of a same-race teacher on test scores and non-test academic outcomes. Section 6 concludes.

## 2 Literature

This paper complements the literature on the impact of same-race teachers on student perceptions and behavioral outcomes by providing direct evidence on the effects of a same-race teacher on student-teacher communication. Previous studies find evidence on the positive effects of a same-race teacher on teacher expectations about student attainment (Gershenson et al., 2016), teacher perceptions of student behavioral outcomes (Dee, 2005), student perceptions and attitudes (Egalite & Kisida, 2018), and behavioral outcomes (Holt & Gershenson, 2019; Lindsay & Hart, 2017). Parallel literature on same-gender teachers shows that female teachers increase female student beliefs in returns to effort (Eble & Hu, 2020) and long-term outcomes (Carrell, Page, & West, 2010; Lim & Meer, 2020).

Gershenson et al. (2018), the closest paper to my study, examines the effects of a same-race teacher on long-term outcomes, including high school graduation, college enrollment, and college test-taking decisions. Gershenson et al. (2018) provide suggestive evidence that the effectiveness of student-teacher communication and role model effects may explain the long-run effects of same-race teachers by exploiting variation in the number of same-race teachers across years. Gershenson et al. (2018) findings suggest that same-race teachers serve as role models when

students decide whether to take college entrance exams (diminishing effect of a second same-race teacher), and teacher-student communication effectiveness explains the positive effect of same-race teachers on college enrollment (increasing effect of a second same-race teacher). In comparison to Gershenson et al. (2018), I study whether exposure to a same-race teacher influences student-teacher communication effectiveness, which may explain the long-term effects of a same-race teacher.

The findings of this paper indicate that exposure to a same-race teacher increases student-teacher communication, which aligns with the findings of Egalite and Kisida (2018) and Alsan, Garrick, and Graziani (2019)[6]. Similar to this paper, Egalite and Kisida (2018) examine the within-teacher racial gap in students' academic perceptions and attitudes and show that Black students taught by a same-race teacher report better perceptions of teaching practices in comparison to White students. However, minority students report on average more positively about teaching practices than non-minority students regardless of a teacher's race. Hence, comparisons between the perceptions of minority and non-minority students may result in an upward bias in the estimated racial gap in student perceptions of teaching practices. In comparison to Egalite and Kisida (2018), I compare student-teacher communication within a group of Black students, enabling me to circumvent bias related to the difference in student reporting across racial groups. Furthermore, I exclude students who exited their randomly assigned classes for other classes/schools in order to focus only on the sample of students initially enrolled in classes with randomly assigned teachers, which enables me to eliminate any bias related to student re-sorting.

This paper further fits into the literature of culturally relevant pedagogy (Dee & Penner, 2017; Irvine, 1989; Ladson-Billings, 1995), according to which Black teachers are better at explaining concepts to same-race students using more relevant exam-

[6] Alsan et al. (2019) document the positive effect of same-race doctors on communication with Black patients, which leads to increasing demand for preventive medical services by Black patients.

ples, as they often have a higher degree of shared cultural background. I find that better explanations by Black teachers to same-race students drive the effects of a same-race teacher on communication effectiveness, which aligns with the 'culturally relevant' hypothesis. This finding may suggest that training non-minority teachers in using culturally relevant pedagogy may complement diversification of the teacher workforce and, in the short term, may improve the performance of minority students. I reject two alternative possibilities: that general higher communication effectiveness by Black teachers and more attention given to same-race students explain the effects of a same-race teacher on communication effectiveness.

This paper also relates to a broader strand of literature on teacher effects and match effects (Aucejo et al., 2019; Graham et al., 2020; Jackson, 2013; Wedenoja et al., 2020) by shedding light on the importance of matching minority students with a same-race teacher. While (Aucejo et al., 2019) highlight the importance of teacher matching with different aspects of a classroom of students, such as higher/lower achievers, I show that teacher matching with same-race students leads to higher effectiveness in communication.

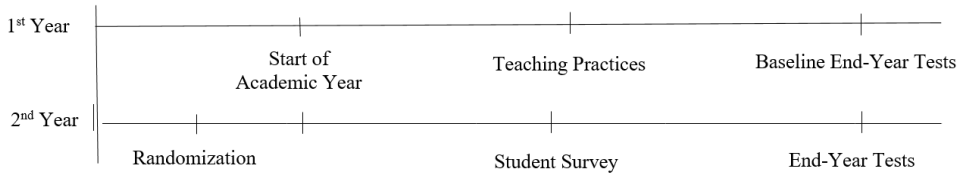
# 3 Data

## 3.1 The MET Project

The Measures of Effective Teaching (MET) project aims to identify effective teachers by exploiting random assignment of teachers within schools (Kane, McCaffrey, Miller, & Staiger, 2013). The MET project took place in six urban school districts[7] over the 2009-2011 academic years. In the first year of study, the MET researchers collected the comprehensive background information on teaching practices

[7]In particular, the districts include New York City Department of Education, Charlotte-Mecklenburg Schools, Denver Public Schools, Memphis City Schools, Dallas Independent School District, and Hillsborough County Public Schools.

**Figure 1. The timeline of the MET project**




and teacher quality and student performance on the baseline end-of-year standardized achievement tests (Figure 1). In the second year of study, the MET researchers randomly assigned the teachers to classrooms within the school-subject-grade, or so-called randomization blocks (Kane et al., 2013). There should be at least two teachers who teach the same grade and subject randomly assigned to a class within each randomization block.

The random assignment of teachers to classes within schools provides exogenous variation in student assignments to same-race teachers. Previous studies employed exogenous variation related to the random assignment of teachers to study the impacts of teacher effectiveness on student outcomes (Aucejo et al., 2019; Blazar & Kraft, 2017). However, they have not exploited it to study the impact of a same-race teacher on student performance. This paper takes advantage of the random assignment of teachers to study the impact of same-race teachers on student test scores and other non-test academic outcomes.

## 3.2 Sample and Descriptive Statistics

The main analytical sample includes elementary school students in 4-5th grades and secondary school students in 6-8th grades whose teachers are randomly assigned[8] and participated in the MET project until the end of the 2010-2011 academic year. Fur-

[8]From the core sample of the second year of the MET project (2,086 teachers from 310 schools), 1,559 randomly assigned teachers from 284 schools continued in the study and 184 teachers dropped out between the random assignment and the start of the school year. Specifically, the number of randomized teachers of grades 4-5 is 470.

thermore, I restrict the sample to students who complied with random assignment to classrooms, and about whom there is available information on socio-demographic characteristics, student perceptions of teaching practices, and test scores. The resulting sample includes students from five school districts[9]. In most cases, primary-school students have one general elementary teacher and the same peers in both subjects for the school year. Secondary-school students have two subject specialist teachers: one each for Math and English. Table A1 presents the summary statistics for the main analytical sample. The sample consists of 21 % Black students, 28 % White students, 40 % Hispanic students, and 11 % other-race students, including Asian, American Indian, and non-specified-race students. The sample is gender-balanced; 48 % of students are Male. More than half (60 %) qualify for the free or reduced-price lunch (FRL) program. 14 % of students are English Language Learners (ELL), 10 % are 'gifted,' and 7 % are classified as having special educational needs.

The racial representation of teachers in the sample includes 74 % who are White and 26 % who are Black[10]. The majority are female (83 %). The overall fraction of students matched to same-race teachers is 41 %; however, there is considerable heterogeneity across racial groups. White students have a considerably higher probability of being taught by same-race teachers at 84 %, while Black students are matched at 51 %.

Table A2 presents the mean of Black and White teacher characteristics. Black teachers in the sample have, on average, about two years less experience than their White counterparts, however, the p-value from the Kolmogorov-Smirnov test indicates that the difference is insignificant. Black teachers are more likely to have a

[9]Initially, schools from six school districts participated in the MET project, however, I do not observe free and reduced-price lunch eligibility of students and prior observed teaching practices in one of the districts.

[10]I restrict the sample to White and Black teachers, as the fraction of Hispanic and other-race teachers is negligible in the original sample.

Master's or higher degree than their White colleagues. In terms of prior observed teaching practices related to communication according to FFT protocol and prior value-added in Math and English, there are no significant differences in these measures of teacher effectiveness between the Black and White teachers.

## 3.3 Measures of Student Performance and Other Non-Test Academic Outcomes

I exploit the end-of-year achievement tests and student perceptions of teaching practices to measure student performance and student-teacher communication effectiveness, respectively. The scores from the end-of-year achievement tests are standardized within the school district, such that test scores have zero mean and unit standard deviation. I use the second-year standardized test scores in Math and English as my outcome variables.

To measure student-teacher communication effectiveness, I use information on student perceptions of teaching practices from the Student Perception (or Tripod) Survey. The Survey contains information on how students evaluate seven dimensions of classroom instruction: Care, Control, Clarify, Challenge, Captivate, Confer, and Consolidate[11]. There are two versions of the survey for elementary-school and secondary-school students. In classes for general teachers, a randomly selected half of the class filled out the survey while thinking about their English class, and the other half completed the survey while thinking about their Math class. Most questions

[11] According to the description of instruments on the Measures of Effective Teaching Longitudinal Database website, these seven dimensions are defined as follows. "Care measures student perceptions of whether the classroom is a safe place. Clarify measures student perceptions of teacher behaviors that help students to better understand the content being taught. Challenge measures student perceptions of classroom rigor and required effort. Captivate measures student perceptions of how well the teacher captures the attention and interest of students. Confer measures student perceptions of how much a teacher takes students' points of view into account when teaching. Consolidate measures student perceptions of how much the teacher helps students cognitively represent what they have learned in a connected way and how well the teacher promotes student understanding of the interconnectedness of different curriculum topics".

on a Tripod survey use Likert-type response options with a 5-point scale (Totally Untrue to Totally True).

The MET researchers created the composite measure of teacher-student interactions exploiting the factor analysis. Six dimensions of teaching practices as perceived by students load on one factor (care, captivate, consolidate, clarify, confer and challenge) with the exception for control. Appendix Table A3 shows the correlation between the different dimensions of classroom instruction evaluated by students and the loadings on each dimension after performing an oblique rotation of the factors. In comparison to the given measure of student-teacher communication, I create alternative measure of the student-teacher communication effectiveness using information on fourteen underlying questions (Table A4) related to communication between teacher and students from Student Survey. The questions are identically formulated across two versions of survey for elementary- and secondary-school students. I conduct the factor analysis to construct the measure of student-teacher communication effectiveness.

# 4 Identification and Estimation

## 4.1 Identification Assumption and Related Issues

The main identification assumption of the impact of same-race teachers is that the probability of being matched with a same-race teacher is not correlated with observable student characteristics, conditional on school-grade-subject fixed effects. I perform a range of balance tests to verify that my identification assumption holds. Columns 1 and 2 of Table A5 provide evidence that exposure to a same-race teacher for Black students within the randomization blocks does not depend on students' observed characteristics, including prior test scores, gender, English language learner (ELL) status, eligibility for free or reduced-price lunch (FRL), 'gifted' or special edu-

cation needs (SPED) status, or enrollment in English and Math classes, respectively. The impact of these variables on being assigned to same-race teachers is jointly insignificant (p-value of 0.61 and 0.29 for each subject, respectively). Columns 3 and 4 of Table A5 similarly show that White student's exposure to a same-race teacher does not depend on student characteristics. Hence, there is no evidence that the main identification assumption of the model does not hold.

Because teachers are randomly assigned to a classroom within the randomization block, the exogeneity of being assigned to a same-race teacher is ensured in the case of perfect randomization. However, there was teacher attrition from the first to the second year of the MET project. Attrition occurred because teachers were not scheduled to teach the grade and subject, or they chose not to participate (Kane et al., 2013). One hundred eighty-four teachers dropped out of the study between the random classroom assignment and the start of the second school year. Despite the teacher attrition, Kane and Staiger (2012) show that samples of teachers participating in the first and second years do not have different characteristics in terms of race and prior teaching experience.

Assignments to a same-race teacher may still be endogenous due to non-random student sorting into classes. If parents of Black students whose parents are more involved are more likely to choose a school/class with same-race teachers, or if high-ability Black students systematically sort into classes taught by Black teachers, the effects of same-race teachers may be overstated. I test whether classroom and teacher characteristics predict non-compliance of students to class assignment. Columns 1 and 2 of Table A6 show that classroom and teacher characteristics do not predict non-compliance of students to classes in Math and English. The exception is in the case of very experienced Math teachers, which is positively correlated with students actively enrolling in their classes, thus potentially violating the assumption of random sorting. However, the impact of classroom and teacher characteristics

is jointly insignificant in Math (p-values is 0.74). Hence, systematic student sorting into classes in terms of observable characteristics is not likely to violate the identification assumption and affect the results.

Another potential identification issue is reverse causality between communication and student test scores. Students who earned higher test scores on state exams may report better communication, and/or students who report effective communication may have a higher level of innate ability. However, the possibility of reverse causality is eliminated by the timing of student reporting on communication and taking state exams. The MET researchers administer the Student Perception Survey in the fall semester (the end of October/ the beginning of November), while state exams were administered at the end of the academic year (April-June). Hence, teacher evaluations of student performance and state exam scores did not influence student reports of their perceptions of teaching practices, which I use to measure teacher-student communication.

## 4.2 Model Specifications

To estimate the effect of a same-race teacher on student outcomes[12], I estimate a linear model:

$$Y^l_{isgk} = \alpha_0 + \alpha_1 BS \times BT_i + \alpha_2 WS \times BT_i + \alpha_3 WS \times WT_i + \alpha_4 X_i + \theta_{sgk} + \epsilon_{isgk} \quad (1)$$

where i, s, g, and k index students, school, grade, and subject, respectively. Upper index l denotes the set of student outcomes, including standardized test scores, teacher-student communication, teacher expectations, and student beliefs. $BS \times BT_i$ is a binary variable equal to one if a Black student i was taught by a Black teacher. $WS \times BT_i$ is a dummy variable equal to one if a White student is taught by a Black

[12]Student outcomes include both test scores and one of non-test academic outcomes, particularly, teacher-student communication effectiveness.

teacher and $WS \times WT_i$ is a dummy variable equal to one if a White student is taught by a White teacher. In the full regression, I also include the binary variables for racial interactions of Black and White teachers with Hispanic and other-race students. The comparison group is Black students taught by White teachers. The within-group comparison of Black students is particularly important for estimating the impact of a same-race teacher on non-exam academic outcomes since it allows me to address the differences in perceptions of teaching practices between students of different racial groups. $X_i$ is a vector of predetermined characteristics of students and teachers, including student prior test scores, gender, English language learner (ELL) status, 'gifted' or special educational needs status (SPED), free or reduced- price lunch eligibility (FRLS), and teacher gender: prior teacher effectiveness is measured by value-added, teacher experience, prior teaching practices are measured according to classroom-based protocol, Framework For Teaching (FFT). $\theta_{sgk}$ are random block or school-grade-subject fixed effects, and $_{ijt}$ is standard error. I cluster standard errors at the level of randomization blocks, which is equivalent to school-grade-subject. The main parameter of interest is $\alpha_1$, which measures the average outcome gains for Black students from being taught by Black teachers compared to Black students taught by White teachers. The parameter related to other combinations of racial interactions, for instance, $\alpha_2$, which stands for the effect of a Black teacher on the outcomes of White students, allows me to shed more light on whether the effect of a same-race teacher is/not confounded by better general teacher ability to communicate. A positive impact of Black teachers on communication with non-matched/other-race students would mean that Black teachers are more effective communicators. If Black teachers are on average better at communication with students of all racial groups, then the effect of a same-race teacher will be overstated.

To estimate the effect of a same-race teacher on test scores, I use a value-added specification that controls for prior test scores on the right-hand side. Although the

value-added model specification may be highly sensitive to endogeneity bias when relevant inputs are omitted (Todd & Wolpin, 2003), it is commonly used by previous literature. Unlike (Dee, 2004), who investigates the effect of a same-race teacher on kindergarten and primary school students and does not observe measures of prior performance or ability, I control for prior student test scores.

# 5 Results

This section presents the main results on the effects of a same-race teacher on student performance and robustness checks. Subsection 5.1 demonstrates the effects of a same-race teacher on student test scores and student-teacher communication effectiveness. Subsection 5.2 documents the heterogeneity of the effects of a same-race teacher and possible underlying mechanisms. Subsection 5.3 describes the robustness checks.

## 5.1 The Effects of a Same-Race Teacher on Test Scores and Communication Effectiveness

In this subsection, I demonstrate the findings on the impacts of same-race teachers on standardized test scores and student-reported communication effectiveness. I find that the effects of a same-race teacher on Math test scores[13] are positive and significant and vary from 0.18 to 0.19 of SD (Columns 1-2 Table 1), however, there is no evidence that a same-race teacher improves English test scores of Black students (Columns 3-4 Table 1). The comparison group is Black students assigned to White teachers in the same school, grade, and subject. The even columns of Table 1 show that the effects of a same-race teacher are robust to inclusion of teacher character-

[13]The effects of a same-race teacher on Math test scores does not vary with prior test scores in the specification which controls for the interaction of a same-race teacher with prior student test scores.

istics including gender, experience within school district, prior value-added[14], prior observed teaching practices according to FFT, and prior average student perceptions of teaching practices. The fact that results are robust to inclusion of teacher characteristics may suggest that systematic differences in teacher effectiveness and other teacher characteristics between Black and White teachers do not drive the result.

**Table 1. The Effects of a Same-Race Teacher on Math and English Test Scores of Black Students**

| Subjects | Math | | English | |
|---|---|---|---|---|
| Black T× Black S | 0.199* | 0.181* | -0.005 | -0.033 |
| | (0.111) | (0.107) | (0.071) | (0.076) |
| Black T× White S | 0.085 | 0.065 | -0.093 | -0.123 |
| | (0.102) | (0.101) | (0.101) | (0.110) |
| White T× White S | 0.054 | 0.055 | -0.001 | -0.007 |
| | (0.049) | (0.049) | (0.045) | (0.046) |
| Male Teacher | | -0.058 | | -0.089 |
| | | (0.060) | | (0.083) |
| Prior Teacher Value-Added | | 0.313* | | -0.005 |
| | | (0.187) | | (0.191) |
| Within-District | | -0.001 | | 0.006** |
| Teacher Experience | | (0.003) | | (0.003) |
| Prior Teaching Practices | | -0.064 | | -0.159* |
| FFT Communication | | (0.079) | | (0.095) |
| Prior Classroom Perception | | 0.027 | | 0.025 |
| of Teaching Practices | | (0.021) | | (0.025) |
| R-squared | 0.739 | 0.741 | 0.685 | 0.687 |
| Observations | 1,504 | 1,504 | 1,972 | 1,972 |

Notes: The comparison group is Black students taught by White teachers. Models include controls for predetermined student characteristics, including prior test scores, student ELL status, SPED status, 'gifted' status, free and reduced-price lunch eligibility, gender, age; teacher gender, prior value-added,prior observed teaching practices in communication and randomization block fixed effects. Standard errors in parentheses are clustered at the level of randomization block.
* p < .10, ** p < .05, *** p < .01

[14]The race of a teacher may be correlated with teacher quality and other observable characteristics that influence teacher ability to communicate and improve student performance. The common measure of teacher quality is teacher value-added, which is weakly correlated with the observable characteristics of teachers, in addition to experience (Rockoff, Jacob, Kane, & Staiger, 2011).

The second row of Table 1 provides evidence that being taught by Black teachers has small positive and insignificant impacts on the performance of White students on Math exams and negative but insignificant effects on English test scores. However, this result should be viewed with caution, as only five percent of White students are taught by Black teachers in the sample. The findings align with previous findings from the randomized STAR study (Dee, 2004)[15] and observational studies Egalite et al. (2015).

Beyond test scores, I also examine the effects of same-race teachers on teacher-student communication effectiveness[16]. The first two columns of Table 2 present the estimated effects of a same-race teacher on communication in English classes, while the second two columns demonstrate the estimates of same-race teachers in Math classes. The comparison group is Black students taught by White teachers. The results[17] in Table 2 indicate that being taught by a same-race teacher increases communication effectiveness with Black students by 0.33 of SD and 0.29 of SD, respectively, in English and Math. The results are robust to controlling for teacher quality measured by prior value-added and prior teaching practices according to FFT (odd columns). The magnitude of the estimated effects of a same-race teacher is comparably larger than the size of estimated effects of same-race doctors on communication with Black patients (Alsan et al., 2019), which may be due to differences in the duration of exposure and contexts.

Results in Rows 2, 4, and 5 of Table 2[18] show that Black teachers have no

[15] I cannot directly compare the magnitudes of estimates, as Dee (2004) used a percentile rank based on test scores from different math and reading tests, and did not control for prior test scores

[16] I also study the effects of a same-race teacher on other non-cognitive skills, including grit, effort, and malleability of skills. The results in Table A7 show that there is a positive impact of a same-race teacher on grit of Black students, however, there are no effects on student effort and malleability of skills. The choice of non-test academic outcomes is defined by the data availability.

[17] Using the alternative measure of teacher-student communication effectiveness, I repeat the analysis on the impact of a same-race teacher. Table A8 show that results are similar in magnitude to results in Table 2 when I use the measure of student-teacher communication constructed from the underlying questions from the Student survey.

[18] These results should be viewed with caution for two reasons: first, the small sample of White students taught by Black teachers may lead to imprecise estimates; second, White students on

significant positive effect on communication with White, Hispanic, and other-race students, suggesting that there are no negative externalities for non-matched students.

**Table 2. The Impacts of a Same-Race Teacher on Student-Teacher Communication Effectiveness**

| Outcome = Communication | English classes | | Math clases | |
|---|---|---|---|---|
| Black T× Black S | 0.329** | 0.338** | 0.348** | 0.294** |
| | (0.166) | (0.156) | (0.141) | (0.144) |
| Black T× White S | 0.102 | 0.098 | 0.047 | 0.011 |
| | (0.174) | (0.155) | (0.161) | (0.153) |
| White T× White S | -0.003 | -0.010 | 0.028 | 0.027 |
| | (0.071) | (0.072) | (0.095) | (0.094) |
| Black T × Hispanic S | -0.073 | -0.034 | 0.063 | 0.015 |
| | (0.164) | (0.157) | (0.145) | (0.139) |
| Black T × Other-race S | 0.060 | 0.081 | -0.058 | -0.101 |
| | (0.144) | (0.125) | (0.218) | (0.212) |
| Teacher controls | No | Yes | No | Yes |
| R-squared | 0.193 | 0.204 | 0.194 | 0.195 |
| Observations | 2,970 | 2,970 | 2,364 | 2,364 |

Notes: The comparison group is Black students taught by White teachers. Models include controls for predetermined student characteristics, including prior test scores, student ELL status, SPED status, 'gifted status', free and reduced-price lunch eligibility, teacher gender, prior value-added, prior observed teaching practices in communication and randomization block fixed effects. Standard errors in parentheses are clustered at the level of randomization block. * p < .10, ** p < .05, *** p < .01

I further explore how much teacher-student communication effectiveness explains the effect of a same-race teacher on test scores. For that, I conduct mediation analysis by including communication as an additional control in the Equation 1. The results in Table 3 indicate that teacher-student communication effectiveness explains only about 4% of the effect of a same-race teacher on Math test scores of Black students. This result should be taken with the caution because of the

average report a lower level of communication than minority students. Hence, the estimated effects may reflect the level difference in reporting from different racial groups of students.

potential issue of measurement error in communication, which may lead to biased results. This result is consistent with the findings of previous studies Blazar and Kraft (2017) on the relationship between the teacher effects on non-test academic outcomes and teacher effects on test scores.

**Table 3. Does Communication Explain the Effect of a Same-Race Teacher on Test Scores?**

| Outcome = Math test scores | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Black T× Black S | 0.229* | 0.220* | 0.219 | 0.213 |
| | (0.132) | (0.129) | (0.136) | (0.133) |
| Black T× White S | 0.064 | 0.065 | 0.050 | 0.050 |
| | (0.114) | (0.111) | (0.113) | (0.110) |
| White T× White S | 0.061 | 0.059 | 0.064 | 0.063 |
| | (0.053) | (0.054) | (0.054) | (0.054) |
| Communication | | 0.044** | | 0.043** |
| | | (0.017) | | (0.017) |
| Teacher Characteristics | No | No | Yes | Yes |
| R-squared | 0.742 | 0.744 | 0.744 | 0.746 |
| Observations | 1,241 | 1,241 | 1,241 | 1,241 |

Notes: The comparison group is Black students taught by White teachers. Models include the same set of controls as in Table 1. Standard errors in parentheses are clustered at the level of randomization block. * p < .10, ** p < .05, *** p < .01

## 5.2 Heterogeneity and Possible Explanations

Heterogeneity analysis of the effects of a same-race teacher on communication shows that Black girls and students who are not eligible for free and reduced-price lunch gain most from being taught by a same-race teacher (Panel A of Table A9). The explanation behind the larger effect of a same-race teacher for girls may be that girls not only share a race with their teacher but also a gender since the majority of teachers are female. I do not find evidence that students with a lower prior performance report better communication. In Panel B of Table A9, I test whether the effect of a same-race teacher varies with teacher characteristics and do not find evidence that the effect differs for teachers with higher prior value-added, teaching

practices, and more years of within-district experience.

The important question remains which mechanisms can explain the positive effect of same-race teacher on communication effectiveness. Using the rich survey information provided in the MET Student Perception Survey, I present evidence on three possible mechanisms, including higher general communication ability of same-race teachers, more attention towards same-race students, and better understating of same-race teacher's explanations. First, the evidence on the lack of positive effects of Black teachers on other-race students (Table 2) suggests that a better general ability to communicate does not drive the effect of a same-race teacher on communication.

**Table 4. Heterogeneity of the Effect of a Same-Race Teacher on Communication: by Racial Composition of Class**

| Outcome = Communication | All classes | English classes | Math classes |
|---|---|---|---|
| Black T× Black S | 0.364** | 0.367* | 0.356** |
| | (0.142) | (0.206) | (0.172) |
| Black T × Black S × | -0.045 | -0.073 | -0.025 |
| Predominantly Black Classes | (0.177) | (0.234) | (0.206) |
| Black T × White S | 0.104 | 0.115 | 0.050 |
| | (0.136) | (0.181) | (0.163) |
| White T × White S | 0.017 | 0.006 | 0.029 |
| | (0.057) | (0.071) | (0.094) |
| Predominantly Black Classes | 0.316 | 0.305 | 0.423* |
| | (0.645) | (0.660) | (0.216) |
| Observations | 5,372 | 2,970 | 2,364 |
| R-squared | 0.186 | 0.194 | 0.194 |

The comparison group is Black students taught by White teachers. Models include controls for predetermined student characteristics, including prior test scores, student ELL status, SPED status, 'gifted' status, free and reduced-price lunch eligibility, teacher gender, prior value-added, prior observed teaching practices in communication and randomization block fixed effects. I define classes with predominantly Black students as those in which more than two-thirds of the students are Black. The first column additionally controls for subject fixed effects. Standard errors in parentheses are clustered at the level of randomization block. *p < .10, **p < .05, ***p < .01

The second potential explanation for the positive effect of a Black teacher on communication effectiveness may be that same-race teachers pay more attention to

matched students. As teacher attention towards a particular student is unobserved, I verify whether the effect of a same-race teacher varies with the fraction of matched students in the class, following Penney (2017b). A teacher in classes with a large fraction of same-race students may give less attention to same-race students than in classes with a small fraction of same-race students due to time constraints. The results in the second row of Table 4 show that the interaction effect of a same-race teacher with dummy for the classes with predominantly Black students is small and insignificant. These results suggest that there is no evidence that Black teachers allocate more attention towards same-race students at the expense of non-matched students.

Third, I examine the effects of a same-race teacher on separate underlying questions related to communication effectiveness (list of questions in Table A4). Column 1 of Table 5 suggests that more effective communication between Black students and teachers (e.g., better understanding of same-race teachers' explanations) explains the positive effect of a same-race teacher on student-teacher communication effectiveness. These results align with the literature on culturally relevant pedagogy (Irvine, 1989; Ladson-Billings, 1995; Dee and Penner, 2017), according to which Black teachers are more effective at instructing same-race students due to shared cultural background.

## 5.3 Discussion and Robustness Checks

In this subsection, I discuss the possible sources of bias and show that results are robust to various robustness checks.

**In-group bias:** One concern is related to the in-group bias. Specifically, Black students may report better communication with same-race teachers as they belong to the same race group but do not indeed have more effective communication. To test this issue, I examine whether Black students also report a higher level of hap-

**Table 5. Impact of a Same-Race Teacher on Components of Teacher-Student Communication**

| Components of Communication | Black T× Black S | Black T× White S | White T× White S | $R^2$ |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Teacher Explanation | 0.254** | -0.012 | 0.012 | 0.155 |
| | (0.108) | (0.124) | (0.063) | |
| Teacher Explanation: Several ways | 0.347*** | 0.130 | -0.042 | 0.148 |
| | (0.113) | (0.143) | (0.060) | |
| Clear Explanation | 0.302*** | 0.153 | 0.012 | 0.169 |
| | (0.109) | (0.120) | (0.054) | |
| Class Understanding | 0.285*** | 0.104 | -0.017 | 0.137 |
| | (0.092) | (0.131) | (0.063) | |
| Clarifying Questions | 0.175** | 0.095 | 0.032 | 0.131 |
| | (0.070) | (0.100) | (0.058) | |
| Checking Understanding | 0.139 | 0.035 | -0.005 | 0.176 |
| | (0.092) | (0.102) | (0.054) | |
| Thoughts Sharing | 0.268* | 0.131 | -0.001 | 0.169 |
| | (0.151) | (0.112) | (0.069) | |
| Students Speak Up | 0.316** | 0.159 | -0.023 | 0.129 |
| | (0.133) | (0.139) | (0.072) | |
| Student Explanation | 0.270*** | 0.187* | 0.102* | 0.121 |
| | (0.102) | (0.112) | (0.059) | |
| Time to Explain | 0.211* | 0.088 | 0.024 | 0.161 |
| | (0.117) | (0.137) | (0.066) | |
| Teacher Summarizing | 0.195* | -0.041 | -0.061 | 0.160 |
| | (0.117) | (0.137) | (0.079) | |
| Correcting mistakes | 0.173* | 0.048 | -0.111** | 0.167 |
| | (0.096) | (0.104) | (0.048) | |
| Care | 0.371*** | 0.149 | 0.142* | 0.208 |
| | (0.137) | (0.156) | (0.079) | |
| Understanding of feelings | 0.176 | 0.088 | 0.041 | 0.121 |
| | (0.174) | (0.164) | (0.084) | |

Notes: The comparison group is Black students taught by White teachers. Models include controls for predetermined student characteristics, including prior test scores, ELL status, SPED status, 'gifted' status, free and reduced-price lunch eligibility, gender, age,teacher gender, prior value-added, prior observed teaching practices in communication, randomization block and subject fixed effects. Sample consists of 4726 observations and include both Math and English classes. Standard errors in parentheses are clustered at the level of randomization block. * p < .10, ** p < .05, *** p < .01

piness and interest when same-race teachers teach them. The results in Table A10 show that Black students do not report a higher level of happiness and do not like classes taught by same-race teachers more than classes taught by other-race teachers, suggesting that in-group bias towards same-race teachers is not likely to drive the results.

**Are the results affected by average higher effectiveness of same-race teachers?** I further test whether the positive effect of same-race teachers stems from same-race teachers being on average more effective at communication than other-race counterparts, I replace the teacher-student communication based on student perceptions with a fixed effect for each teacher to further analyze the teacher's ability to communicate. Afterward, I explore which teacher characteristics correlate with fixed effects estimates obtained from the regression with communication as an outcome variable (Table A11). Teacher race explains approximately 60 % of the cross-sectional variation, but the effect of teacher race is small and insignificant. This implies that there is no significant difference in time-invariant teacher ability to communicate between Black and White teachers. In the next four columns of Table A11, I add dummies for whether a teacher taught in classes with predominantly Black classes, a content knowledge test, a principal survey rating (PSVY), and teacher experience within the district. The correlation between time-invariant teacher communication ability and those teacher characteristics is positive and insignificant, except for teacher experience. These teacher characteristics do not explain much about the variation in teacher fixed effects. These results provide suggestive evidence that there is no significant difference in time-invariant teacher ability to communicate between White and Black teachers.

**Are the results affected by the exposure to a same-race teacher in previous grade?** The estimated effects of a same-race teacher on test scores and communication effectiveness may be biased by exposure to a same-race teacher in

previous grades. Penney (2017a) finds that the effect of having a second same-race teacher is relatively small; however, earlier exposure to same-race teachers is more beneficial than in later grades. If the effect of a second same-race teacher is decreasing, the estimated effects in Table 1 may be understated and reflect a lower bound of the true estimates.

# 6 Conclusion

This paper investigates the impacts of same-race teachers on student test scores and non-test academic outcomes, particularly the effectiveness of communication between students and teachers. Exploiting the random assignment of teachers to classes within MET project schools in the U.S., I show that having a same-race teacher improves Math test scores of Black students and does not influence English test scores. These results align with findings of previous studies (Dee, 2005; Egalite et al., 2015; Joshi et al., 2018). I also find that matched Black students may have more effective communication with same-race teachers than do their unmatched schoolmates.

This paper contributes to the literature on the effects of same-race teachers on student non-test academic outcomes by providing evidence that the effects of same-race teachers extends beyond test scores and positively affects teacher-student communication effectiveness. This paper also relates to a broader strand of literature on teacher effects and match effects (Aucejo et al., 2019; Graham et al., 2020; Jackson, 2013; Wedenoja et al., 2020) by shedding light on the importance of matching minority students with a same-race teacher.

The findings on the effect of a same-race teacher on the dimensions of teacher-student communication suggest that a better understanding of a same-race teacher's explanations due to cultural background may explain the positive effect of a same-

race teacher. These findings are consistent with the literature hypothesis on culturally relevant pedagogy (Dee & Penner, 2017; Ladson-Billings, 1995), according to which the effects of a same-race teacher on communication may be explained by a shared cultural background. These findings may suggest that training non-minority teachers in using culturally relevant pedagogy can improve the performance of minority students through enhanced classroom communication. Such training may complement long-term policy interventions, particularly hiring more minority teachers, which requires extensive financing to attract minority graduates from alternative highly-paid non-teaching jobs (Gershenson et al., 2018). Additionally, I test two alternative explanations for the positive effect of a same-race teacher on communication effectiveness, including higher general communication ability of Black teachers and more teacher attention directed towards matched students. The latter suggests that gains for matched students are not at the expense of non-matched students.

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# Appendix A

**Table A1. Descriptive Statistics**

| | Mean (1) | St. deviation (2) | Min (3) | Max (4) |
|---|---|---|---|---|
| **Panel A:** Student Characteristics | | | | |
| Black | 0.21 | 0.41 | 0.00 | 1.00 |
| Hispanic | 0.40 | 0.49 | 0.00 | 1.00 |
| White | 0.28 | 0.45 | 0.00 | 1.00 |
| Other race | 0.11 | 0.31 | 0.00 | 1.00 |
| Male | 0.48 | 0.50 | 0.00 | 1.00 |
| ELL | 0.14 | 0.34 | 0.00 | 1.00 |
| Gifted Status | 0.10 | 0.30 | 0.00 | 1.00 |
| Special Education Status | 0.07 | 0.25 | 0.00 | 1.00 |
| FRL | 0.60 | 0.49 | 0.00 | 1.00 |
| Age | 10.48 | 1.51 | 7.62 | 14.56 |
| Prior Math Test Scores | 0.25 | 0.91 | -3.00 | 3.17 |
| Prior English Test Scores | 0.25 | 0.94 | -2.93 | 2.87 |
| **Panel B:** Teacher Characteristics | | | | |
| Black | 0.26 | 0.44 | 0.00 | 1.00 |
| White | 0.74 | 0.44 | 0.00 | 1.00 |
| Male | 0.17 | 0.37 | 0.00 | 1.00 |
| Experience within district | 8.26 | 7.34 | 0.00 | 41.00 |
| Master degree | 0.27 | 0.45 | 0.00 | 1.00 |
| Prior Teaching Practices | 2.62 | 0.35 | 1.59 | 3.50 |
| FFT: Communication | | | | |
| Prior Value-Added | 0.09 | 0.216 | -1.06 | 0.67 |
| **Panel C:** Outcomes | | | | |
| Communication | 0.06 | 0.91 | -4.49 | 1.77 |
| Clarify | 0.04 | 0.59 | -3.31 | 1.43 |
| Confer | 0.02 | 0.68 | -3.62 | 1.36 |
| Care | 0.06 | 0.79 | -3.27 | 1.44 |
| Consolidate | 0.05 | 0.79 | -2.54 | 1.20 |
| Captivate | 0.03 | 0.79 | -2.51 | 1.24 |
| Challenge | 0.03 | 0.68 | -3.5 | 0.95 |
| Control | 0.05 | 0.70 | -2.49 | 1.37 |

Notes: The sample comprises data on the 2010-2011 school year in which teachers were randomly assigned to classes within randomization blocks.

**Table A2. Teacher Characteristics and Quality**

| | Years of Experience | Master Degree | Prior FFT Math | Prior FFT English | Prior VA Math | Prior VA English |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Black mean | 6.84 | 0.49 | 2.58 | 2.61 | 0.035 | -0.003 |
| White mean | 8.73 | 0.21 | 2.65 | 2.70 | 0.009 | 0.003 |
| P values | 0.110 | 0.000 | 0.460 | 0.198 | 0.217 | 0.441 |

Notes: Table reports means of teacher characteristics by race. P-values are taken from the Kolmogorov-Smirnov test.

**Table A3. "7C" Student Perception Correlations and Factor Loadings**

| | Clarify | Care | Confer | Consolidate | Captivate | Challenge | Control | Communication Loadings | Strictness Loadings |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Clarify | 1 | | | | | | | 0.4247 | -0.0061 |
| Care | 0.6868 | 1 | | | | | | 0.4200 | 0.0209 |
| Confer | 0.6705 | 0.6788 | 1 | | | | | 0.4170 | 0.0321 |
| Consolidate | 0.6442 | 0.5371 | 0.5836 | 1 | | | | 0.4273 | -0.0677 |
| Captivate | 0.5947 | 0.5022 | 0.4713 | 0.4124 | 1 | | | 0.3590 | 0.1168 |
| Challenge | 0.5867 | 0.3860 | 0.4551 | 0.3171 | 0.2435 | 1 | | 0.3974 | -0.0818 |
| Control | 0.3933 | 0.4478 | 0.4089 | 0.3246 | 0.3409 | 0.2551 | 1 | -0.0091 | 0.9867 |
| P values | 0.110 | 0.000 | 0.460 | 0.198 | 0.217 | 0.441 | | | |

Note: The first seven columns show correlations between "7C" student perception components of teaching practices. The last two columns present factor loadings from exploratory factor analysis after performing an oblique rotation and keeping the first two factors. The first factor explains 62 % of the variance in the data, and the second explains another 11 % of variance.

**Table A4. Underlying Questions Related to the Teacher-Student Communication Effectiveness**

| # | Question from the Survey | |
|---|---|---|
| 1. | If you don't understand something, my teacher explains it another way. | Teacher Explanation |
| 2. | My teacher has several good ways to explain each topic that we cover in this class | Teacher Explanation: Several Ways |
| 3. | My teacher explains difficult things clearly. | Clear Explanation |
| 4. | My teacher knows when the class understands, and when we do not. | Class Understanding |
| 5. | My teacher asks questions to be sure we are following along when he/she is teaching. | Clarifying Questions |
| 6. | My teacher checks to make sure we understand what he/she is teaching us. | Checking Understanding |
| 7. | My teacher wants us to share our thoughts. | Thoughts Sharing |
| 8. | Students speak up and share their ideas about class work. | Students Speak Up |
| 9. | My teacher wants me to explain my answers – why I think what I think. | Student Explanation |
| 10. | My teacher gives us time to explain our ideas. | Time to Explain |
| 11. | My teacher takes the time to summarize . what we learn each day | Teacher Summarizing |
| 12. | In this class, we learn to correct our mistakes. | Correcting mistakes |
| 13. | My teacher in this class makes me feel that she/he really cares about me. | Care |
| 14. | My teacher seems to know if something is bothering me. | Understanding of feelings |

**Table A5. Balance Tests**

| | Black students | | White students | |
|---|---|---|---|---|
| Outcome = Same-race teacher | English (1) | Math (2) | English (3) | Math (4) |
| Prior test score | -0.024 | -0.031 | 0.008 | 0.006 |
| | (0.016) | (0.021) | (0.09) | (0.012) |
| ELL status | -0.107 | -0.067 | 0.005 | -0.046 |
| | (0.144) | (0.099) | (0.09) | (0.039) |
| FRL eligibility | -0.021 | 0.001 | 0.003 | -0.008 |
| | (0.026) | (0.027) | (0.024) | (0.015) |
| 'Gifted' status | 0.038 | 0.070 | 0.000 | 0.031 |
| | (0.063) | (0.063) | (0.031) | (0.026) |
| Male Student | -0.021 | 0.013 | -0.014 | 0.003 |
| | (0.020) | (0.016) | (0.018) | (0.018) |
| SPED Student | 0.001 | -0.041 | 0.014 | -0.006 |
| | (0.045) | (0.056) | (0.031) | (0.019) |
| Observations | 1,050 | 875 | 1,032 | 807 |
| R-squared | 0.6465 | 0.6975 | 0.5621 | 0.7348 |
| Joint test F-statistics | 0.75 | 1.24 | 0.22 | 0.76 |
| [p-value] | 0.6125 | 0.2929 | 0.9697 | 0.6064 |

Notes: The dependent variable is an indicator for being taught by a same-race teacher, regressed on student characteristics, controlling for randomization block or school-grade-subject fixed effects. Standard errors in parentheses are clustered at the level of randomization block.

**Table A6. Non-Compliance of Students to Classes Taught by Randomly Assigned Teachers**

| Outcome = Non-complier | Math Classes | English Classes |
|---|---|---|
| Non-complier | (1) | (2) |
| Black Teacher | 0.025 | 0.016 |
| | (0.029) | (0.023) |
| Male Teacher | 0.012 | 0.083 |
| | (0.021) | (0.064) |
| Prior Value-Added | -0.026 | 0.050 |
| | (0.051) | (0.058) |
| Teacher Experience | 0.003* | -0.001 |
| | (0.002) | (0.001) |
| Prior Classroom | 0.013 | 0.007 |
| Average Test Score | (0.038) | (0.039) |
| Fraction of Black students | 0.031 | 0.066 |
| | (0.181) | (0.198) |
| Fraction of Hispanic students | -0.079 | 0.003 |
| | (0.117) | (0.202) |
| Fraction of Other-race students | -0.056 | 0.328 |
| | (0.101) | (0.304) |
| Fraction of ELL students | -0.099 | -0.121 |
| | (0.101) | (0.130) |
| Fraction of 'Gifted' students | -0.119 | -0.054 |
| | (0.211) | (0.106) |
| Fraction of Male students | -0.008 | -0.020 |
| | (0.121) | (0.198) |
| Fraction of FRL students | 0.117 | -0.029 |
| | (0.158) | (0.090) |
| Fraction of SPED students | 0.048 | 0.138 |
| | (0.155) | (0.158) |
| Observations | 5,156 | 5,861 |
| R-squared | 0.7212 | 0.6426 |
| Joint test F-statistic | 0.73 | 0.42 |
| P-value | 0.7434 | 0.9656 |

Notes: Each column reports the results from the one regression in which the outcome variable is non-compliance status of students,which equals one if student is a non-complier and zero otherwise. Non-compliers are students who were initially assigned to a class with randomly assigned teachers but specifically opted out for another class or school. Students who were initially assigned to Math classes taught by teachers with more experience are more likely to be non-compliers. The impact of these variables is jointly insignificant (F-statistics= 0.73, p-value is 0.7434).

**Table A7. The Impact of a Same-Race Teacher on Other Non-Test Academic Outcomes**

| Math-specific outcomes | Grit | | Effort | | Skills maleability | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Black T× Black S | 0.263* | 0.260* | 0.130 | 0.128 | -0.042 | -0.030 |
| | (0.151) | (0.150) | (0.130) | (0.129) | (0.139) | (0.136) |
| Black T× White S | 0.035 | 0.046 | -0.041 | -0.033 | -0.236 | -0.229 |
| | (0.150) | (0.150) | (0.137) | (0.142) | (0.165) | (0.166) |
| White T× White S | -0.099 | -0.104 | -0.133* | -0.139* | -0.132 | -0.135* |
| | (0.097) | (0.099) | (0.071) | (0.071) | (0.081) | (0.081) |
| Black T× Hispanic S | -0.151 | -0.150 | -0.183 | -0.175 | -0.028 | -0.009 |
| | (0.141) | (0.138) | (0.114) | (0.111) | (0.119) | (0.118) |
| Black T× Other-Race S | 0.081 | 0.078 | -0.031 | -0.041 | -0.303 | -0.299 |
| | (0.194) | (0.195) | (0.180) | (0.186) | (0.211) | (0.208) |
| Teacher Characteristics | No | Yes | No | Yes | No | Yes |
| R-squared | 0.168 | 0.169 | 0.113 | 0.117 | 0.172 | 0.174 |
| Observations | 2,036 | 2,036 | 2,284 | 2,284 | 2,229 | 2,229 |

Notes: The comparison group is Black students taught by White teachers. Models include controls for predetermined student characteristics, including prior test scores, student ELL status, SPED status, 'gifted status', free and reduced-price lunch eligibility, teacher gender, prior value-added, prior observed teaching practices and randomization block fixed effects. Standard errors in parentheses are clustered at the level of randomization block. *p < .10, **p < .05, ***p < .01

**Table A8. The Impact of a Same-Race Teacher on Student-Teacher Communication: Alternative Measures**

| Outcome = | English classes | | Math classes | |
|---|---|---|---|---|
| Communication | (1) | (2) | (3) | (4) |
| Black T × Black S | 0.311** | 0.319** | 0.337** | 0.293** |
| | (0.154) | (0.137) | (0.131) | (0.136) |
| Black T × White S | 0.156 | 0.164 | -0.014 | -0.044 |
| | (0.152) | (0.128) | (0.173) | (0.171) |
| White T × White S | 0.044 | 0.024 | -0.019 | 0.016 |
| | (0.069) | (0.067) | (0.089) | (0.088) |
| Black T × Hispanic S | -0.057 | -0.005 | 0.039 | 0.001 |
| | (0.159) | (0.145) | (0.143) | (0.142) |
| Black T × Other-race S | 0.117 | 0.138 | 0.099 | 0.065 |
| | (0.122) | (0.131) | (0.165) | (0.161) |
| Teacher Controls | No | Yes | No | Yes |
| Observations | 2,630 | 2,630 | 2,067 | 2,067 |
| R-squared | 0.227 | 0.244 | 0.239 | 0.242 |

Notes: The comparison group is Black students taught by White teachers. Models include controls for predetermined student characteristics, including prior test scores, student ELL status, SPED status, 'gifted status', free and reduced-price lunch eligibility, teacher gender, prior value-added, prior observed teaching practices in communication and randomization block fixed effects. Standard errors in parentheses are clustered at the level of randomization block. *p < .10, **p < .05, ***p < .01

**Table A9. Heterogeneity of the Effect of a Same-Race Teacher on Communication with Black Students: by Student and Teacher Characteristics**

| Panel A: Student Characteristics | | | |
|---|---|---|---|
| X= | Prior Test Score | Male | Low-Income Family |
| | (1) | (2) | (3) |
| Same-race teacher × X | -0.038 | -0.128* | -0.185* |
| | (0.053) | (0.069) | (0.096) |
| Same-race teacher | 0.327*** | 0.395*** | 0.460*** |
| | (0.120) | (0.123) | (0.127) |
| X | 0.033 | -0.075** | 0.025 |
| | (0.023) | (0.030) | (0.035) |
| R-squared | 0.193 | 0.193 | 0.193 |
| Panel B: Teacher Characteristics | | | |
| X= | Prior Value-Added | Prior Teaching Practices | Within-District Experience |
| | (1) | (2) | (3) |
| Same-race teacher × X | -0.057 | -0.087 | -0.001 |
| | (0.297) | (0.079) | (0.010) |
| Same-race teacher | 0.338*** | 0.334*** | 0.340*** |
| | (0.119) | (0.117) | (0.124) |
| X | 0.510 | 0.016 | -0.014** |
| | (0.350) | (0.049) | (0.006) |
| R-squared | 0.193 | 0.193 | 0.193 |
| Observations | 5,349 | 5,349 | 5,349 |

Notes: The comparison group is Black students taught by White teachers. Models include controls for predetermined student characteristics, including prior test scores, student ELL status, SPED status, 'gifted status', free and reduced-price lunch eligibility, teacher gender, prior value-added, prior observed teaching practices in communication and randomization block fixed effects. Standard errors in parentheses are clustered at the level of randomization block.
*p < .10, **p < .05, ***p < .01

**Table A10. Robustness Check: In-group Bias**

| Math-specific outcomes | Happiness | | Like Classes | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Black T× Black S | 0.018 | -0.049 | 0.027 | -0.008 |
| | (0.162) | (0.166) | (0.110) | (0.115) |
| Black T× White S | -0.139 | -0.186 | -0.089 | -0.115 |
| | (0.153) | (0.148) | (0.147) | (0.139) |
| White T× White S | 0.089 | 0.092 | -0.120* | -0.121* |
| | (0.089) | (0.089) | (0.071) | (0.072) |
| Teacher controls | No | Yes | No | Yes |
| R-squared | 0.151 | 0.157 | 0.191 | 0.196 |
| Observations | 2,333 | 2,333 | 2,364 | 2,364 |

Notes: The comparison group is Black students taught by White teachers. Models include controls for predetermined student characteristics,including prior test scores, student ELL status, SPED status, 'gifted' status, free and reduced-price eligibility, gender, age; teacher gender, prior value-added, prior observed teaching practices and randomization block fixed effects. Standard errors in parentheses are clustered at the level of randomization block.
* p < .10, ** p < .05, *** p < .01

**Table A11. Correlations between Teacher FE and Teacher Characteristics**

| | Teacher FE | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Black Teacher | 0.032 | 0.043 | 0.094 | 0.118 | 0.232 |
| | (0.175) | (0.182) | (0.281) | (0.187) | (0.373) |
| Taught in predominantly black classes | | 0.104 | | | |
| | | (0.329) | | | |
| Content Knowledge Test | | | 0.002 | | |
| | | | (0.013) | | |
| Principal Survey Rating (PSVY) | | | | 0.103 | |
| | | | | (0.064) | |
| Within-District Experience | | | | | -0.075 |
| | | | | | (0.074) |
| Observations | 111 | 111 | 99 | 102 | 55 |
| R-squared | 0.6060 | 0.6064 | 0.6075 | 0.6227 | 0.7035 |

Notes: The subsample includes randomized teachers. Teacher fixed effects are calculated from the regression of communication on teacher fixed effects controlling for student characteristics.