# Racial/Ethnic Match and Student-Teacher Relationships

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Kien Le & My Nguyen[†]

**Abstract**

This paper explores the role of teacher race/ethnicity in the teacher-perceived relationships with early elementary school students. Employing a model with both student and teacher fixed effects, we discover a positive link between the racial/ethnic match and the teacher-reported relationships with students. Specifically, minority students tend to have closer and more positive relationships with their teachers than white students when they are taught by a minority teacher. Adapted rank-based tests of discrimination reveal that the favorable teacher-reported relationships with students are not prompted by teachers favoring their own kind or discriminating against opposite-race students. We further show that the estimated favorable impacts are driven by minority students reacting positively when they have a minority teacher but adversely once assigned to a white teacher, which is consistent with the role model effect. Given the importance of the relationships between young children and non-parental adults in their early stages of life, these findings have crucial policy implications.

*JEL codes*: I20, I21, J15, J18

*Keywords*: Racial/Ethnic Interaction, Relationship Scale, Minorities, Non-labor Discrimination

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## 1 Introduction

The white-minority achievement gap has long been regarded as one of the persistent and serious issues of the educational system in the United States. The test score gap formed in primary school continues to middle and secondary education (Fryer and Levitt 2006), which consequently turns into divergent postsecondary outcomes (Arcidiacono et al. 2012) as well as lifetime earnings (Chetty et al. 2014b). Attempt to minimize the white-minority achievement gap has become a focal point of various education reforms. Given the rapidly changing demographic composition of the student body, increasing the representation of minority teachers to raise academic outcomes for minority students has been proposed as one solution to achievement gap problem (Joint Center for Political Studies 1989; National Commission on Teaching and America's Future 1996; Clewell and Villegas 1998).

In spite of the more racially diverse student body, the U.S. teacher workforce remains quite homogeneous. According to the U.S. Department of Education (2016), in the 2011-2012 academic year, the fraction of white teachers in K-12 public schools was 82%, compared to the 51% white students. Black and Hispanic students, respectively, accounted for 16% and 24% of the student body, whereas the fractions of black and Hispanic teachers were 7% and 8%, respectively (U.S. Department of Education 2016). This lack of minority teachers could potentially impose a number of disadvantages on minority students, the population of which is projected to increase.[1] Disadvantages include (but not limited to) restricted exposure to teachers of similar cultures, the lack of role models, and the possibility of discrimination.

In this paper, we present the first empirical evidence of the link between the classroom racial/ethnic interactions and teacher-perceived relationships with students as well as teacher evaluations of student development in early years. Specifically, we test whether a minority student could have more positive relationships with his/her teacher and develop better noncognitive as well as cognitive skills if he/she is assigned to a minority teacher.[2] This is an important question since the teacher-student relationships in early years could affect students' current learning motivation, long-term behaviors and academic achievement (Pianta and Nimetz 1991; Hamre and Pianta 2001). To examine the relationship of interest, we employ the confidential version of the Early Childhood Longitudinal Studies-K: 2011 (ECLS-K:2011) dataset. The ECLS-K:2011 allows me to observe the same student from kindergarten to the second grade along with his/her classroom teachers. Besides showing the role of teacher

[1] According to the current population report by the United States Census (Colby et al. 2017), the minority population is expected to rise from 38 percent to 55 percent within 2014 and 2060.

[2] Minority refers to the African American (black) and Hispanic group.

race/ethnicity in the teacher-student relationship scale, another contribution of this paper is to disentangle the mechanism behind the racial/ethnic interaction effect. Particularly, we implement the adapted rank-based test of discrimination by Anwar and Fang (2006) to test for any trace of taste-based discrimination from the teacher side. This is the first paper to conduct the test of discrimination in the context of elementary school education.

This paper is related to the literature of exploring the impact of same-race/same-gender teachers on students' outcomes. Regarding gender, a vast majority of prior studies reach a conclusion that there are positive effects of gender interactions in the classroom on students' achievement (Dee 2007, Bettinger and Long 2005, Hoffmann and Oreopoulos 2009, Carrell et al. 2010)[3] . Extending beyond academic measures, Gong et al. (2018) shows that female teachers improve noncognitive outcomes among female students. With respect to race/ethnicity, the literature provides ample evidence on the impacts on academic performance. Specifically, it is documented that the racial/ethnic interactions between students and teachers generate considerable gains in test scores among primary school children (Dee 2004), middle and high school students (Egalite et al. 2015), as well as improvements in course taking, course grades, retention status, degree obtainment among college students (Fairlie et al. 2014, Lusher et al. 2018). The closest work to this paper is Dee (2005) which examines how the racial dynamics influence teacher perceptions of student performance, proxied by the frequency of being disruptive, inattentive, as well as doing homework. However, Dee (2005) does not disentangle the source of the racial interaction effect, i.e., whether the effect stems from the role-model effect (student behavior change) or from teacher bias.

In terms of methodology, we employ a model integrating both the student and the teacher fixed effects to estimate the causal effects of exposure to same race/ethnicity teachers on student outcomes. The incorporation of two levels of fixed effects can rule out systematic differences among students matched to different teachers regardless of their racial/ethnic background, and at the same time eliminates the effect of disparate teacher quality and/or classroom-specific shocks. Therefore, our estimates of the causal impacts of same race/ethnicity teachers come from both the within-teacher and within-student variations. To further strengthen the causal claim, we conduct a falsification test which explores the "influence" of racial/ethnic interactions with second-grade teachers on students' kindergarten outcomes.

We detect positive impacts of the racial/ethnic interactions on the teacher-student relationships. Specifically, minority students are likely to have closer and more positive relationships

[3] One exception is Antecol, Eren, and Ozbeklik (2014) which detects a negative impact of female teachers on female students' mathematics test score.

with the classroom teacher than white students if the teacher is a minority (by 0.288 and 0.323 standard deviations in the Closeness and Positiveness scores, respectively). There is no differential impact on teacher evaluations of student noncognitive skills nor student cognitive ability. We further show that effects on the teacher-student relationships are not driven by teachers favoring their own kind or discriminating against opposite-race students, but are prompted by minority students exhibiting better manners when they are matched with minority teachers. There is also evidence that white students do not behave differently in a minority-taught and a white-taught class.

The remainder of the paper is organized as follows: Section 2 describes the data. Section 3 presents the estimation strategy. Main results and the falsification test are reported in Section 4 and Section 5, respectively. Section 6 discusses mechanisms and tests of discrimination. Section 7 concludes the paper.

## 2 Data

### 2.1 Overview and variables

To estimate the role of the racial/ethnic interactions between teachers and students, we employ the Early Childhood Longitudinal Study, Kindergarten Class of 2010-2011 (ECLS-K:2011). This U.S. based dataset consists of a nationally representative sample of children in kindergarten through elementary classes. The ECLS-K:2011 was collected from the spring 2011, when the majority of children were in kindergarten to the spring 2013, when most of them were in the second grade. Drawn from many sources such as parent interviews, teacher/school administrator questionnaires, and directly administered assessment tests, the ECLS-K:2011 provides rich information ideal for the purpose of this study.

Besides the common demographic details (race, ethnicity, gender), the unique feature of the ECLS-K:2011 is the availability of the comprehensive assessments of student development. Student cognitive and non-cognitive skills are evaluated based on both direct assessment tests and teacher evaluations. For every student, teachers showed how they perceived the relationship with the student and provided subjective evaluations of the student's learning behaviors as well as academic ability. In this paper, we look at three sets of student outcomes: (i) teacher-perceived relationships with the student, (ii) teacher evaluations of student learning behaviors, and (iii) student cognitive ability captured by both direct assessment tests and teacher subjective evaluations.

To measure the relationships between teachers and students, we use the Teacher-Student Relationship Scale variables: Closeness and Conflict. The Closeness score indicates the level of affection and open communication the teacher reported to have with the student. On the other hand, the Conflict score specifies the extent of negative feelings the teacher experienced with the student. These two variables are built from teachers' responses to 15 descriptive statements about their perceived relationship with each of the student. These responses are on the scale from 1-"definitely does not apply" to 5-"definitely applies".[4,5] We standardize these scores by questionnaire period (the spring semester for each of the school year) so that in each period, Closeness and Conflict scores have zero mean and unit variance. Besides the Closeness and Conflict variables, we construct another two indices, Positiveness and Negativeness using the method proposed by Duflo et al. (2007) and Kling et al. (2007). Particularly, we first compute z-scores for each of the 7 underlying items for Closeness, each of the 8 underlying items for Conflict. Then, we take simple average of the z-scores and re-standardize the averages across kindergarten and second-grade years to form the Positiveness and Negativeness scores.

Measures of the child's learning behaviors are constructed from teacher evaluations of each student. To assess student's learning behaviors, teachers were required to respond to 7 individual questions, phrased *"For the set of items below, please think about this child's behavior during the past month or two. Decide how often the child demonstrates the behavior described"*. The question addresses 7 different sets of the student's behavior: Keep belongings organized, Show eagerness to learn new things, Work independently, Easily adapt to changes in routines, Persist in completing task, Pay attention well, Follow classroom rules (Tourangeau et al. 2017). Each item variable takes value from 1-"never" to 4-"very often".[6] Also present in the data, the Approach-to-Learning score is constructed from these 7 items by calculating the simple average of the items when the teacher responded to at least 4 items. For the ease of interpretation, we obtain the standardized measure of the Approach-to-Learning score. Besides, we also create a slightly different measure, the Learning index, as follows. We first standardize 7 item scores by questionnaire period so that during each spring semester, those variables have zero mean and unit variance. Following Duflo et al. (2007) and Kling et al. (2007), we take simple average of the z-scores of the item variables and re-standardize the

[4] Response to individual item is given on a scale: 1-"definitely does not apply", 2-"not really", 3-"neutral, not sure", 4-"applies sometimes", 5-"definitely applies". The 15 items that constitute the Closeness and Conflict variables are not presented in this paper due to the confidentiality of the data.

[5] The Closeness and Conflict scores are available in the ECLSK-2011 dataset. These scores, present only when the teacher responds to at least 5 items, are the simple average of their individual items.

[6] Response is on the scale: 1-"never", 2-"sometimes", 3-"often", 4-"very often".

averages. Therefore, the Learning is re-standardized across kindergarten and second-grade years.

The final set of outcomes is student cognitive ability, captured by direct assessment tests and teacher's evaluation of each student's math and reading skills. Assessment tests are on math, reading, and executive functions. Executive functions are defined as "interdependent processes that work together to regulate and orchestrate cognition, emotion, and behavior and that help a child to learn in the classroom.", Tourangeau et al. 2017. Teachers evaluated student cognitive skills by responding to the following question *"How would you rate this child's academic skills in each of the following area, compared to other children of the same grade level"*, on a scale of 1-"far below average", 2-"below average", 3-"average", 4-"above average", 5-"far above average". *"Each of the following area"* refers to math and reading, separately. All assessments and evaluations were taken from the spring semester of each year.

### 2.2 Sample restrictions and summary statistics

The main explanatory variable of interest is the racial/ethnic match between students and teachers, therefore, we only keep observations with non-missing race/ethnicity information. Second, we limit the analysis to white, black, and Hispanic students and teachers, the three main racial/ethnic groups in the U.S. Finally, we only keep students who are in the sample during both kindergarten and the second-grade years. These restrictions result in 9,040 students and 6,410 teachers, from a total of 1,510 schools.

Descriptive statistics are provided in Table 1. Panel A shows the teacher-student relationship scale variables. Positiveness and Negativeness are standardized to have zero mean and unit variance. Closeness and Conflict scores, respectively, have means of 0.053 and -0.012 of a standard deviation. Teacher subjective evaluations of student learning behaviors are presented in Panel B. The short name of each variable used in the analysis is displayed in the parentheses. The Approach to Learning (ATL) score has a mean value of 0.014. The Learning index has zero mean and unit variance by construction. In Panel C, direct assessment of student cognitive ability is captured in math score, reading score, and executive functions scores.[7] Also included in Panel C is the indirect assessment of student cognitive ability, teacher subjective ratings of student math and reading skills.

The racial/ethnic composition of both students and teachers is demonstrated in Panel D. The majority of students are white (60%) while the shares of Hispanic and black students are

[7] Students' executive functions are measured by administering the Card Sort Game and Numbers Reverse Game. Students' performance in these games makes up the Card Sort Composite Score and Number Reverse Ability Score. Details of the two games are provided in Tourangeau et al. (2017).

**Table 1:** Summary Statistics

| | Mean | SD | Observations |
|---|---|---|---|
| **Panel A: Teacher-reported Relationships with Students** | | | |
| Closeness | 0.053 | 0.968 | 17,790 |
| Positiveness | 0 | 1 | 17,570 |
| Conflict | -0.012 | 0.992 | 17,790 |
| Negativeness | 0 | 1 | 17,520 |
| **Panel B: Teacher-reported Student Learning Behaviors** | | | |
| Approach to learning (ATL) | 0.014 | 0.989 | 17,780 |
| Learning index (Learning) | 0 | 1 | 17,560 |
| Showing eagerness to learn (Eagerness) | 0.008 | 0.99 | 17,780 |
| Good at following classroom rules (Follow) | 0.017 | 0.99 | 17,780 |
| Pay attention well (Attention) | 0.012 | 0.992 | 17,770 |
| Persistent in doing tasks (Persistent) | 0.01 | 0.991 | 17,750 |
| Being organized (Organized) | 0.008 | 0.996 | 17,720 |
| Easily adapt to changes (Adapt) | 0.011 | 0.989 | 17,730 |
| Independent in doing tasks (Independent) | 0.011 | 0.992 | 17,790 |
| **Panel C: Test Scores, Executive Functions and Academic Skill Evaluation** | | | |
| Math test score | 0.011 | 0.974 | 17,880 |
| Reading test score | 0.021 | 0.969 | 17,890 |
| Evaluation of Math Skill | -0.0004 | 0.985 | 17,720 |
| Evaluation of Reading Skill | 0.006 | 0.993 | 17740 |
| Card Sort Composite Score | 0.019 | 0.979 | 17,850 |
| Number Reverse Ability Score | 0.019 | 0.983 | 17,890 |
| **Panel D: Student and Teacher Shares by Race/Ethnicity** | Students | Teachers | |
| White | 0.60 | 0.84 | |
| Black | 0.13 | 0.05 | |
| Hispanics | 0.27 | 0.11 | |
| Observations | 9,040 | 6,410 | |
| Number of schools | 1,510 | | |

NOTE: Sample size is rounded to the nearest ten due to the confidential nature of the data

27% and 13%, respectively. Looking at teachers, white teachers dominate the sample (84%). Minority teachers who are Hispanic and black only take up 11% and 5%, respectively. The racial component of teachers in our sample is close to the national share of each group in the K-12 teacher workforce.[8] Evident from Panel D, despite the more diverse student body, the teacher workforce remains quite racially homogeneous.

[8] U.S. Department of Education (2016)

## 3 Empirical Methodology

To explore the effect of teacher race/ethnicity on the teacher-student relationships, student noncognitive and cognitive outcomes, we use the following regression model,

$$y_{ijt} = \beta_0 + \beta_1 MinorityStudent_i \times MinorityTeacher_{jt} + X'_{it}\Omega + \lambda_i + \delta_j + \epsilon_{ijt} \qquad (1)$$

where $y_{ijt}$ is the outcome for student $i$ of teacher $j$ in year (grade) $t$, and $t$ includes the kindergarten and the second-grade year. The dummy $MinorityStudent_i$ takes the value of 1 if student $i$ is either black or Hispanic and 0 otherwise. $MinorityTeacher_{jt}$ is an indicator variable which equals 1 if teacher $j$ in year $t$ is either black or Hispanic and 0 otherwise. $X_{it}$ is a vector of observable student characteristics, including retention status, special accommodation status, socioeconomic measure, whether the student changes teacher during one academic year. We denote by $\lambda_i$ the student fixed effects and by $\delta_j$ the teacher fixed effects. Finally, $\epsilon_{ijt}$ is the error term.

Specification (1) can overcome many threats to internal validity. Particularly, the inclusion of student fixed effects is intended to eliminate the possibility that students in a minority-taught class are systematically different from those in a white-taught class, regardless of the student's racial/ethnic background. The presence of teacher fixed effects guards against the probability that students are assigned to teachers who have different teaching styles, evaluation standards, qualifications, etc. Furthermore, if there is a minority gap that exists in all classes, irrespective of teacher characteristics, it is controlled for by student fixed effects. The coefficient estimate of interest is $\beta_1$, which measures the extent to which the minority gap in the outcome variables (i.e. the difference in the outcome between minority and white students) depends on whether the students are assigned to a minority or a white teacher. A positive $\beta_1$ indicates that minority students receive more favorable outcomes relative to their white peers when they are matched with a minority teacher. In the model including two degrees of fixed effects like equation (1), standard errors are clustered at the teacher level and student level.

Besides relying on the within-teacher within-student comparisons, we include only teacher fixed effects, and look at the impact of the racial/ethnic interactions separately in the kindergarten and second-grade year,

$$y_{ij} = \beta_0 + \beta_1 MinorityStudent_i \times MinorityTeacher_j + \beta_2 MinorityStudent_i + X'_{it}\Omega + \delta_j + \epsilon_{ij} \qquad (2)$$

Teacher fixed effect is still represented by $\delta_j$. Apart from the controls defined in equation

(1), $X_i'$ in equation (2) also includes student gender and language spoken at home. Standard errors in equation (2) are clustered at the teacher level.

An alternative to equation (1) is to examine how the teacher-student relationships, student noncognitive and cognitive outcomes are affected if a student is matched with a teacher sharing the same racial/ethnic group (for example, a white student with a white teacher, a minority student with a minority teacher),

$$y_{ijt} = \alpha_0 + \alpha_1 same_{ij} + X_{it}'\Theta + \lambda_i + \delta_j + \epsilon_{ijt} \tag{3}$$

where $same_{ij}$ takes the value of 1 if there is a racial match and 0 otherwise. The coefficient $\alpha_1$ captures the similar race effects.[9]

## 4 Results

### 4.1 Racial match and the teacher-student relationship scale

Table 2 presents the estimates of the teacher race/ethnicity effect on the teacher-perceived relationships with students, where the racial/ethnic interaction effect, $\beta_1$, is reported. Panel A shows our preferred specification, i.e. equation (1), including both student and teacher fixed effects. This identification strategy which relies on the within teacher within student comparisons is also utilized in Dee (2007), Hoffmann and Oreopoulos (2009), and Fairlie et al. (2014). In addition, we also implement the model involving only one level of fixed effects, the teacher fixed effects, i.e. equation (2), for the full two-year sample (Panel B) and separately for each year of kindergarten and second grade (Panel C and D, respectively). In all specifications, there is a positive minority interaction effect on the student-teacher relationship scores.

Evident from Panel A, there is an increase in the difference of the teacher-student relationship scale between minority and white students (or a reduction of the minority gap) when students are exposed to minority teachers. A minority student, when matched with a minority teacher, receives higher teacher-student Closeness score (Column 1) and Positiveness score (Column 3) by 0.288 and 0.323 standard deviations, respectively, than a white student. There is a reduction in the Conflict and Negativeness scores although the estimates are not statistically significant at conventional levels. Taken together, the estimating results from the teacher and student fixed effects model highlight the importance of the racial/ethnic dynamics between students and teachers in shaping teacher perceptions of their relationships.

[9] Details are provided in Appendix B

**Table 2:** Estimated Role of Minority Teacher for Teacher-Student Relationships

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Closeness | Conflict | Positiveness | Negativeness |
| **Panel A**: Teacher and Student Fixed Effects - Full Sample | | | | |
| $MinorityStudent \times MinorityTeacher$ | 0.288** | -0.039 | 0.323** | -0.032 |
| | (0.125) | (0.131) | (0.138) | (0.135) |
| Observations | 17,790 | 17,790 | 17,570 | 17,520 |
| **Panel B**: Teacher Fixed Effects - Full Sample | | | | |
| $MinorityStudent \times MinorityTeacher$ | 0.180** | -0.065 | 0.179** | -0.055 |
| | (0.086) | (0.103) | (0.0885) | (0.103) |
| Observations | 17,790 | 17,790 | 17,570 | 17,520 |
| **Panel C**: Teacher fixed effects - Kindergarten | | | | |
| $MinorityStudent \times MinorityTeacher$ | 0.243** | -0.003 | 0.221** | 0.025 |
| | (0.098) | (0.138) | (0.101) | (0.135) |
| Observations | 8,830 | 8,830 | 8,710 | 8,690 |
| **Panel D**: Teacher Fixed Effects - Second Grade | | | | |
| $MinorityStudent \times MinorityTeacher$ | 0.094 | -0.121 | 0.119 | -0.136 |
| | (0.138) | (0.139) | (0.144) | (0.141) |
| Observations | 8,960 | 8,960 | 8,860 | 8,830 |

NOTE: Each cell is a separate regression of relationship outcomes on the racial/ethnic interactions, conditioning on student characteristics, teacher and student fixed effects (Panel A), or only teacher fixed effects (Panel B, C, D). Standard errors are clustered at the teacher and student level (Panel A), or at the teacher level (Panel B, C, D). Sample size is rounded to the nearest ten. In Panel A, student controls include student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year. In addition, cross sectional regressions in Panel B, C, D also control for student gender, race, and language spoken at home. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

We proceed to the cross-sectional estimations. In Panel B, the teacher fixed effects specification shows qualitatively similar results although the point estimates are somewhat smaller (0.18 for both Closeness and Positiveness). Estimates from cross-sectional regressions which show the impacts of the racial/ethnic match separately by year are provided in Panel C and D of Table 2. There seems to be stronger effects of the racial/ethnic interactions during kindergarten as evidenced by statistically and economically significant coefficient estimates. Nevertheless, the impacts appear to be weaker in the second grade as coefficient estimates are statistically insignificant and smaller in magnitude than those in other specifications. Turning to the teacher-reported Conflict score and the Negativeness score, the coefficient estimates on the racial/ethnic interactions are negative but are statistically indistinguishable from zero.[10]

[10] In Appendix Table B4, we show various specifications for the outcome teacher-student relationship scale. Column 1 in Table B4 is the same as Panel A in Table 2 for comparison. Changing the cluster level keeps the significance intact (Column 4-5, Table B4). Changing the fixed effects level somewhat leaves qualitatively similar results. With the exclusion of teacher fixed effects (Column 2-3, Table B4), there is a

**Table 3:** Estimated Role of Minority Teacher for Teacher-Student Relationships, using a sample of four racial/ethnic groups

| | Teacher Race/Ethnicity | | | Teacher Race/Ethnicity | |
|---|---|---|---|---|---|
| | Black | Hispanic | | Black | Hispanic |
| **Closeness** | | | **Conflict** | | |
| Observations | 17,790 | | Observations | 17,790 | |
| Black | -0.031 | 0.680** | | 0.005 | -0.182 |
| | (0.211) | (0.277) | | (0.240) | (0.275) |
| Hispanic | 0.485** | 0.341** | | -0.237 | 0.01 |
| | (0.234) | (0.166) | | (0.228) | (0.172) |
| **Positiveness** | | | **Negativeness** | | |
| Observations | 17,570 | | Observations | 17,520 | |
| Black | -0.005 | 0.749** | | -0.022 | -0.175 |
| | (0.226) | (0.298) | | (0.247) | (0.273) |
| Hispanic | 0.507** | 0.384** | | -0.197 | 0.029 |
| | (0.259) | (0.184) | | (0.231) | (0.179) |

NOTE: This table demonstrates results from outcome regressions where interactions between all student and teacher race/ethnicities are included. The full set of four identified interactions for each regression is reported. All interactions involving white students or teachers are unidentified. These regressions are conditioned on both teacher and student fixed effects, student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year. Standard errors are clustered at the teacher and student level. Sample size is rounded to the nearest ten. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

To investigate further the level at which student-teacher interactions are present, we show estimates from regressions where separate interactions across all detailed racial/ethnic groups are included. Student fixed effects absorb the interaction for one of the student groups (white students in this case), while teacher fixed effects absorb the interaction for one of the teacher groups (white teacher in this case). Consequently, we end up with 4 of the 9 race/ethnicity interactions. All estimated interaction effects in Table 3 are relative to the relationship scale for white students with alternative teacher types.

For the teacher-student Closeness score and the Positiveness score, we find a stronger effect for cross-race/ethnicity interactions. Minority students could have favorable relationships with minority teachers of a different type. This is consistent with Fairlie et al. (2014) which also documents better outcomes for minority students once matched with minority instructors of a different racial type. Particularly, we find that a black student tends to

statistically insignificant increase in the Closeness score and Positiveness score but a statistically significant decline in the Conflict score and Negativeness score. In other words, minority students are less likely to have conflicts (negative relationships) with their teachers if their teachers also have a minority status.

have closer relationships with the classroom teacher than a white student by 0.68 standard deviations (measured by the Closeness score) if they are assigned to a Hispanic teacher. A similar differential effect is observed between a Hispanic student and a white student are assigned to a black teacher (For Closeness (Positiveness) score, the estimate is 0.485 (0.507) standard deviations). For own-race interactions, although positive impacts are detected between Hispanic students and Hispanic teachers, no such relationship is uncovered between black students and black teachers.

### 4.2 Racial match, student learning behaviors, and student cognitive ability

The estimated role of teacher race/ethnicity for student learning behaviors is presented in Table 4. we only present results for the specification incorporating both teacher and student fixed effects. Although the coefficients on the racial/ethnic interaction term are positive, there is not enough statistical evidence for the effect on student learning behaviors to be detected.

**Table 4:** Estimated Role of Minority Teacher for Student Learning Behaviors

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | ATL | Learning | Eagerness | Follow | Attention |
| $MinorityStudent \times MinorityTeacher$ | 0.079 | 0.086 | 0.102 | -0.090 | -0.012 |
| | (0.107) | (0.114) | (0.140) | (0.123) | (0.132) |
| Observations | 17,780 | 17,560 | 17,780 | 17,780 | 17,770 |
| | Persistent | Organized | Adapt | Independent | |
| $MinorityStudent \times MinorityTeacher$ | 0.058 | 0.222 | 0.036 | 0.138 | |
| | (0.127) | (0.153) | (0.138) | (0.132) | |
| Observations | 17,750 | 17,720 | 17,730 | 17,790 | |

NOTE: Each cell is a separate regression of outcomes on the racial/ethnic interactions, conditioning on student characteristics, teacher and student fixed effects. Standard errors are clustered at the teacher and student level. Student controls include student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year. Sample size is rounded to the nearest ten. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

The estimated impacts on student cognitive ability are presented in Table 5. In contrast to Dee (2004), we don't find any impact of the racial/ethnic match on student test scores. Point estimates are small in magnitude and statistically indistinguishable from zero. Moving to teacher subjective evaluations, although the effect on student math skill is positive, it is both economically and statistically insignificant. Regarding the reading evaluation, Column 3 in the lower panel of Table 5 suggests a shrinking white-minority achievement gap by 0.194 standard deviations in reading if students are taught by minority teachers. However, this

narrowing gap is not captured by assessment test performance.[11] Taken together, there is not enough evidence that exposure to minority teachers improves cognitive ability for minority students.

**Table 5:** Estimated Role of Minority Teachers for Student Cognitive Ability

| | (1) | (2) | (3) |
|---|---|---|---|
| | Math Score | Reading Score | Card Sort |
| $MinorityStudent \times MinorityTeacher$ | -0.042 | -0.0004 | -0.066 |
| | (0.08) | (0.101) | (0.174) |
| Observations | 17,880 | 17,890 | 17,850 |
| | Number Reverse | Math Evaluation | Reading Evaluation |
| $MinorityStudent \times MinorityTeacher$ | -0.065 | 0.037 | 0.194* |
| | (0.139) | (0.121) | (0.111) |
| Observations | 17,890 | 17,720 | 17,740 |

NOTE: Each cell is a separate regression of outcomes on the racial/ethnic interactions, conditioning on student characteristics, teacher and student fixed effects. Standard errors are clustered at the teacher and student level. Student controls include student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year. Sample size is rounded to the nearest ten. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

## 5 Falsification Test

Collectively, we find that minority students tend to have more positive teacher-student relationships and exhibit a higher level of closeness with their teachers than white students when they are assigned to minority teachers. The teacher and student fixed effects specification is able to guard off most threats to omitted variable bias; however, it cannot eliminate the contamination due to relative sorting. In other words, if well-behaved minority kids systematically sort into minority-taught classes while well-behaved white kids do not, our estimated effects of teacher-student racial/ethnic interactions are likely to be biased. Therefore, to provide suggestive evidence against relative sorting, we conduct a falsification test by examining the "effect" of the teacher-student racial/ethnic match during second-grade year on the teacher-student relationship scale in kindergarten. The falsification test controls for student characteristics (race, gender, socioeconomic status, retention, special accommodation

[11] In order to shed some light on whether this reflects real gains in reading for minority students, we execute a falsification test similar to those described in the next section where kindergarten teacher evaluation of the child's reading skill is regressed on the racial/ethnic interaction with the second-grade teacher, conditioning on student characteristics and teacher fixed effects. The differential effect from this regression is 0.072. Compared to the actual effect of the racial/ethnic match between the student and his kindergarten teacher on evaluations in kindergarten (which is 0.067), the falsification estimate (despite being insignificant) is too large to negate any spurious link between racial/ethnic interactions and teacher evaluation of student reading skill. In other words, there is no relative gain in reading skill for minority students matched with minority teachers.

status, age, home language), and teacher fixed effects. If there were to be a spurious impact of the racial/ethnic interactions on teacher-student relationships, the coefficient estimate on the interaction term in the falsification test would be statistically distinct from zero.

Table 6 presents the results of the falsification test. The coefficients on the second-grade racial interaction are economically and statistically insignificant for Past Closeness and Past Positiveness (0.02 for Past Closeness; 0.01 for Past Positiveness where "past" refers to the kindergarten year). The estimates for Past Conflict and Past Negativeness carry opposite (wrong) sign. P-values are very high. The results from the falsification test further strengthen our estimated effects of the teacher-student racial/ethnic interactions on the teacher-perceived relationships with students.

**Table 6:** Falsification Test

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Past Closeness | Past Conflict | Past Positiveness | Past Negativenes |
| $MinorityStudent\times$ $MinorityTeacher$ | 0.02 (0.136) | 0.04 (0.153) | 0.01 (0.143) | 0.03 (0.157) |
| p-value | 0.882 | 0.779 | 0.926 | 0.849 |
| Observations | 8,830 | 8,830 | 8,710 | 8,690 |

NOTE: Each cell is a separate regression of relationship variables in Kindergarten on the Second-grade racial/ethnic interactions, conditioning on student characteristics, and teacher fixed effects. Standard errors are clustered at the teacher level. Student controls include student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year, student gender, race, and language spoken at home. Sample size is rounded to the nearest ten. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

## 6 Mechanisms and Discussion

In this section, we explore the mechanisms behind the racial/ethnic interaction effects. The estimated favorable impacts of the teacher-student racial/ethnic match on the teacher-perceived relationships with students could potentially be driven by either teachers or students behaving differently (Dee 2004). On one hand, teachers may favor students of their own race or be biased against those of different racial/ethnic identities (Casteel 1998; Zimmerman et al. 1995; Ferguson 2003). On the other hand, students might feel more comfortable and focused as well as exhibit more positive behaviors once being assigned to same-race/same-ethnicity teachers (U.S. Department of Education 1997; Ladson-Billings 1994). In order to disentangle these two possibilities, We execute several tests of discrimination to see if teachers are showing

bias against students from a different racial/ethnic group.[12]

First, we run a regression of the teacher-student relationship scale (Closeness and Positiveness) on teacher fixed effects and the interactions between teacher effects and student race/ethnicity indicators. We conduct the joint significance tests for all coefficients on the interactions. These interaction effects capture the variation in teacher-specific minority-white relationship gaps. As shown in Table B1 in Appendix B, coefficients on these interactions are statistically distinct from zero, implying there are indeed differences in the way teachers perceive their relationships with minority and white students.

**Table 7:** Test of Discrimination 2

| | Teacher Race/Ethnicity | | | | Teacher Race/Ethnicity | | |
|---|---|---|---|---|---|---|---|
| | White | Minority | P-Value | | White | Minority | P-Value |
| Student Race/ Ethnicity | **Closeness** | | | | **Positiveness** | | |
| White | 0.145 | 0.083 | 0.002 | White | 0.093 | 0.027 | 0.08 |
| | (0.924) | (1.002) | | | (0.955) | (1.03) | |
| Observations | 10,300 | 440 | | Observations | 10,190 | 430 | |
| Minority | -0.045 | -0.158 | <0.001 | Minority | -0.101 | -0.211 | <0.001 |
| | (1.002) | (1.03) | | | (1.03) | (1.06) | |
| Observations | 4,680 | 2,370 | | Observations | 4,630 | 2,320 | |

NOTE: Standard errors of the means are in parentheses. Sample size is rounded to the nearest ten

Second, we adapt the rank-based test in Anwar and Fang (2006) to test for the presence of taste-based discrimination. Particularly, we denote by $\gamma(W, w)$ and $\gamma(M, w)$ the average relationship scale (Closeness and Positiveness) reported by white and minority teachers with white students, respectively. Similarly, $\gamma(W, m)$ and $\gamma(M, m)$ stand for the average relationship scale between white teachers and minority students and between minority teachers and minority students, respectively. When $\gamma(W, w) > \gamma(M, w)$, white teachers tend to have more positive relationships with white students than minority teachers. When $\gamma(W, m) > \gamma(M, m)$, white teachers are also inclined to provide higher relationship score for minority students than minority teachers. If both conditions hold at the same time,

$$\gamma(W, w) > \gamma(M, w) \tag{4}$$

$$\gamma(W, m) > \gamma(M, m) \tag{5}$$

[12] Since we only uncover effects on Closeness and Positiveness scores, tests of discrimination are conducted only on these variables.

in other words, if the ranking of the average teacher-student relationship scale by race/ethnicity of teachers is preserved, it supports the hypothesis of no discrimination from teachers. On the other hand, if it is true that $\gamma(W,w) > \gamma(M,w)$ and $\gamma(W,m) < \gamma(M,m)$, i.e., the rank order is not preserved, either white or minority teachers are exercising discrimination.

Results of this test are given in Table 7 for the teacher-reported Closeness and the Positiveness scores. White teachers have higher relationship score (both Closeness and Positiveness) with white students than minority teachers. The difference is statistically significant at conventional levels. The results also indicate that white teachers hold more positive relationships with minority students than minority teachers (-0.045 > -0.158; -0.101 > -0.211) and the difference is statistically different from zero. Table 7 suggests that there is no racial discrimination from the teacher side.

**Table 8:** Test of Discrimination 3

| | Teacher Race/Ethnicity | | | | Teacher Race/Ethnicity | | |
|---|---|---|---|---|---|---|---|
| | White | Minority | P-Value | | White | Minority | P-Value |
| Student Race/ Ethnicity | **Residualized Closeness** | | | | **Residualized Positiveness** | | |
| White | 0.003 | -0.06 | 0.08 | White | 0.003 | -0.063 | 0.08 |
| | (0.924) | (1.002) | | | (0.956) | (1.033) | |
| Observations | 10,300 | 440 | | Observations | 10,190 | 430 | |
| Minority | 0.036 | -0.072 | <0.001 | Minority | 0.035 | -0.071 | <0.001 |
| | (1.002) | (1.029) | | | (1.033) | (1.06) | |
| Observations | 4,680 | 2,370 | | Observations | 4,630 | 2,320 | |

NOTE: Standard errors of the means are in parentheses. Sample size is rounded to the nearest ten

There is one caveat in interpreting the results in Table 7. The test of discrimination in Anwar and Fang (2006) rests on the assumption that white and minority troopers are faced with the same population of white and minority motorists. However, in our case, systematic differences may arise because white and minority teachers could be assigned to a different population of white and minority students. To eliminate these differences, we adopt the technique in Depew et al. (2017) by running a regression of relationship outcomes (both Closeness and Positiveness) on student race/ethnicity and year fixed effects. The mean residuals from these regressions grouped by the race/ethnicity of teachers and students are presented in Table 8. White teachers tend to have better relationships with white students than minority teachers (0.003 > -0.06; 0.003 > -0.063). Furthermore, white teachers also hold higher relationship scores with minority students than minority teachers (0.036 > -0.072; 0.035 > -0.071). These differences are statistically different from zero. Taken together, Table 8 also suggests that

there is no racial prejudice from the teacher side.

Results from the three tests of discrimination show that teachers are not biased in their perceived relationships with students. Therefore, the estimated effects of the teacher-student racial/ethnic interactions on the teacher-student relationships are attributable to changes in student behaviors. To put it differently, it is the students who react favorably when they are assigned to teachers sharing their race/ethnicity. The estimates reported in Table 2 reflect the relative gain which could potentially be driven by either minority students responding positively or white students reacting adversely to minority teachers. In order to shed more light on the source of this relative gain, we focus on students from each racial/ethnic group separately (white vs minority students) and run the following specification,

$$y_{ijt} = \beta_1 OppositeRace_j + \beta_2 X_{it} + \lambda_i + T_j + \epsilon_{ijt} \tag{6}$$

where $T_{jt}$ is a vector of teacher characteristics (education, gender, whether the teacher is a high-quality teacher based on the state standard, whether teacher took the exam for national board for professional teaching certification standard). For minority students, $OppositeRace_j$ takes the value of 1 if the teacher is white and 0 otherwise. For white students, $OppositeRace_j$ takes the value of 1 if the teacher is minority and 0 otherwise. $\beta_1$ is the effect of being assigned to a teacher of the opposite racial/ethnic identity relative to being assigned to a same race/ethnicity teacher. $\lambda_i$ stands for student fixed effects. The vector of student covariate, $X_{it}$, includes student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year. The estimating results are provided in Table 9. Evident from Panel A, there is a propensity among minority students to have more conflicts and more negative relationships with white teachers. However, as shown in Panel B, the relationships between white students and minority teachers are undifferentiated from those between white students and white teachers.

Collectively, the estimated racial/ethnic interaction effects are driven by minority students reacting negatively when matched with white teachers but positively when assigned to minority teachers. This behavior is related to the concept of "in-group favoritism" where individuals from the same group respond to each other positively due to the perception of the shared culture but are likely to negatively react to outsiders (Tajfel and Turner 1979). The social interactions between in-group members and out-group individuals are also reported in multiple prior studies. For example, Chen and Li (2009), Bernhard et al. (2006) and Mussweiler and Ockenfels (2013) show that in-group members are more inclined to punish out-group members for misbehaving. Additionally, Levine et al. (2014) document that

members of a racially homogeneous group of traders tend to trust each other's actions in financial markets.

**Table 9:** Estimated Role of Minority Teacher for Teacher-Student Relationships, Group Regressions

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Closeness | Conflict | Positiveness | Negativeness |
| **Panel A: Minority Students** | | | | |
| *OppositeRace* | -0.072 | 0.111** | -0.095* | 0.109** |
| | (0.049) | (0.044) | (0.053) | (0.046) |
| Observations | 7,050 | 7,050 | 6,950 | 6,930 |
| **Panel B: White Students** | | | | |
| *OppositeRace* | 0.012 | 0.048 | 0.029 | 0.057 |
| | (0.073) | (0.064) | (0.076) | (0.065) |
| Observations | 10,740 | 10,740 | 10,620 | 10,590 |

NOTE: Each cell is a regression of relationship outcomes on the *OppositeRace* teacher dummy, conditioning on teacher characteristics and student fixed effects. Student controls include student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year. Teacher characteristics consist of education, gender, whether the teacher is a high-quality teacher based on the state standard, whether teacher took the exam for national board for professional teaching certification standard. The comparison group is own-race teacher. Standard errors clustered at the teacher level are provided in the parentheses. Sample size is rounded to the nearest ten. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

The favorable impacts of the teacher-student racial/ethnic interactions on the teacher-student relationships have fundamental policy implications, given the role of teachers in shaping student outcomes not only during formal school years but also in the future (Chetty et al. 2011, Chetty et al. 2014a, Chetty et al. 2014b). Specifically, negative relationships with teachers induce school avoidance, lack of cooperation in the classroom (Birch and Ladd 1997), and increasing aggressive behaviors (Birch and Ladd 1998). On the contrary, positive relationships with teachers make it easier for students to adapt to the classroom environment (Entwisle and Hayduk 1988; Pianta and Nimetz 1991; Lynch and Cicchetti 1992; Pianta et al. 1995; Birch and Ladd 1997), to feel protected from unsupportive families (Cicchetti and Lynch 1993), and develop important social as well as academic skills (Baker et al. 2008, O'Connor et al. 2011). The quality of the teacher-student relationships is predictive of student long-term behavioral as well as academic outcomes (Pianta and Nimetz 1991, Hamre and Pianta 2001). Therefore, increasing the representation of minority teachers is likely to help narrow the white-minority achievement gap, in a sense that a higher proportion of minority teachers improves outcomes for minority students without doing any harm to their white peers.

## 7 Conclusion

Using the confidential version of the ECLS-K:2011, we provide the first empirical evidence of the causal link between the teacher-student racial/ethnic interactions and teacher-perceived relationships with students in kindergarten and early elementary school. Our identification strategy hinges upon both the within-teacher and the within-student variation. we find that compared to their white peers, minority students tend to have better relationships with teachers when they are assigned to minority teachers. Specifically, minority students are likely to have closer relationships with their teachers by 0.288 standard deviations (of the Closeness score) and tend to hold more positive relationships with their teachers by 0.323 standard deviations (of the Positiveness score) when they are allocated to a minority-taught class. These positive impacts on the teacher-student relationships are discovered both across minority groups (Hispanic teachers and black students, black teachers and Hispanic students) and within the same minority group (Hispanic teachers and Hispanic students, but not between black students and black teachers). However, having a minority teacher does not seem to have any influence on the difference in learning behaviors and cognitive ability between white and minority students.

Examining the mechanisms behind the estimated link between racial/ethnic interactions and teacher-student relationships, we rule out the teacher channel by conducting the tests of discrimination. Both versions of the adapted rank-based test reveal that teachers are not biased in judging their relationships with their students, implying that the source of the racial/ethnic interaction effects comes from student behavior changes. We further show that it is minority students who react adversely when they are assigned to white teachers, whereas white students' behavior remains similar when the teacher is either white or minority. Given the importance of the teacher-student relationships in both the short run and the long run, our results indicate that increasing exposure of minority students to minority teachers could narrow the white-minority achievement gap through improvements in both future academic performances and behavioral outcomes for minority students.

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# A Appendix A

In appendix A, we provide the estimates using all three years (kindergarten through second grade). The results remain qualitatively similar if the first grade is included. Table A1 presents the effects of the racial/ethnic interactions on teacher-student relationship scale.

**Table A1:** Estimated Role of Minority Teacher for Teacher-Student Relationships

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | **Closeness** | **Conflict** | **Positiveness** | **Negativeness** |
| **Panel A**: Teacher and Student Fixed Effects - Full Sample | | | | |
| $MinorityStudent \times MinorityTeacher$ | 0.208*** | -0.103 | 0.219*** | -0.100 |
| | (0.074) | (0.072) | (0.079) | (0.073) |
| Observations | 25,980 | 25,980 | 25,660 | 25,620 |
| **Panel B**: Teacher Fixed Effects - Full Sample | | | | |
| $MinorityStudent \times MinorityTeacher$ | 0.171** | -0.055 | 0.172** | -0.051 |
| | (0.07) | (0.082) | (0.072) | (0.082) |
| Observations | 25,980 | 25,980 | 25,660 | 25,620 |
| **Panel C**: Teacher Fixed Effects - Kindergarten | | | | |
| $MinorityStudent \times MinorityTeacher$ | 0.286*** | -0.011 | 0.261*** | 0.018 |
| | (0.098) | (0.142) | (0.101) | (0.139) |
| Observations | 8,570 | 8,560 | 8,450 | 8,430 |
| **Panel D**: Teacher Fixed Effects - First Grade | | | | |
| $MinorityStudent \times MinorityTeacher$ | 0.131 | -0.054 | 0.134 | -0.061 |
| | (0.103) | (0.113) | (0.108) | (0.113) |
| Observations | 8,720 | 8,720 | 8,610 | 8,610 |
| **Panel E**: Teacher Fixed Effects - Second Grade | | | | |
| $MinorityStudent \times MinorityTeacher$ | 0.066 | -0.095 | 0.095 | -0.110 |
| | (0.142) | (0.140) | (0.148) | (0.143) |
| Observations | 8,690 | 8,700 | 8,600 | 8,580 |

NOTE: Each cell is a separate regression of relationship outcomes on the racial/ethnic interactions, conditioning on student characteristics, teacher and student fixed effects (Panel A), or only teacher fixed effects (Panel B, C, D, E). Standard errors clustered at the teacher and student level (Panel A), or at the teacher level (Panel B, C, D, E) are provided in the parentheses. In panel A, student controls include student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year. In addition, cross sectional regressions in panel B, C, D, E also control for student gender, race, and language spoken at home. Sample size is rounded to the nearest ten. $^{*}p < 0.1$, $^{**}p < 0.05$

The preferred specification (Panel A) shows a significant reduction in the teacher-student relationship gap between minority and white students when they are taught by a minority teacher. Specifically, minority students assigned to minority teachers receive higher Closeness (Positiveness) score by 0.208 (0.219) of a standard deviation compared to white students. In other words, minority kids have better relationships with their teachers than their white

peers if the teacher is either black or Hispanic. Point estimates are close to those in Table 2 where the first grade is excluded (which are 0.288 and 0.323 standard deviations respectively). The sign of all coefficients is preserved with very close magnitude. Alternative specifications for the same outcomes are reported in Panel B through D.

**Table A2:** Falsification Test

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Past Closeness | Past Conflict | Past Positiveness | Past Negativeness |
| **Panel A**: Second-grade racial/ethnic interaction | | | | |
| $MinorityStudent \times MinorityTeacher$ | -0.01 | 0.084 | -0.02 | 0.073 |
| | (0.139) | (0.153) | (0.145) | (0.157) |
| p-value | 0.942 | 0.584 | 0.891 | 0.644 |
| Observations | 8,570 | 8,560 | 8,450 | 8,430 |
| **Panel B**: First-grade racial/ethnic interaction | | | | |
| $MinorityStudent \times MinorityTeacher$ | 0.05 | 0.04 | 0.07 | 0.08 |
| | (0.120) | (0.133) | (0.121) | (0.129) |
| p-value | 0.698 | 0.788 | 0.588 | 0.533 |
| Observations | 8,570 | 8,560 | 8,450 | 8,430 |

NOTE: Each cell is a separate regression of relationship variables in Kindergarten on the First-grade (Panel B) or Second-grade (Panel A) racial/ethnic interactions, conditioning on student characteristics, and teacher fixed effects. Standard errors are clustered at the teacher level. Student controls include student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year, student gender, race, and language spoken at home. Sample size is rounded to the nearest ten. $^{*}p < 0.1$, $^{**}p < 0.05$

Now we turn to the falsification test for the "influence" of the teacher race in second grade and first grade on the student relationship with his/her kindergarten teacher. Outcome variables in these regressions are the teacher-student relationship scale in kindergarten. Explanatory variable of interest is the racial/ethnic interaction in the second grade year (Table A2, Panel A) and in the first year (Table A2, Panel B). In Panel A, coefficients are small and carry opposite sign to those in Table A1. Exposure to teachers of similar racial/ethnic identities in the second grade is indeed uncorrelated with the teacher-student relationships during kindergarten. Moreover, the statistically and economically insignificant estimates are also detected in Panel B. Particularly, having a minority teacher in the first grade improves the student-teacher relationships in kindergarten by 0.05 (0.07) standard deviations of the Closeness (Positiveness) score for a minority student. Compared to the true estimates (0.131 and 0.134) in Panel D of Table A1, the falsification estimates are about 38-52% of the true

estimates.[13] The magnitude of the estimates from the falsification test is quite large for the first year. Referring back to the main results in the main text, falsification estimates in Table 6 are only about 8-21% of the true estimates in Table 2.

For completeness, the results on student learning behaviors, and cognitive ability are reported in Table A3 and A4, respectively. Table A5 and A6 present the ranked-based test of racial discrimination (corresponding to Table 7-8 in the main text). The rank order is preserved, therefore, there is evidence that teachers are not biased in stating their relationships with students from a different racial/ethnic group. Table A7 corresponds to Table 9 in the main text except that observations in the first-grade year are used. Table A7 also suggests that minority students are driving the estimated effects by reacting positively to minority teachers but negatively to white teachers.

Taken together, due to the relatively large magnitude of the coefficient estimate in the first-grade falsification regression, we focus on the racial/ethnic interactions between students and teachers in kindergarten and second grade in the main text. As shown in this appendix, the inclusion of the first grade does not substantially change the results.

**Table A3:** Estimated Role of Minority Teacher for Student Learning Behaviors

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | ATL | Learning | Eagerness | Follow | Attention |
| $MinorityStudent \times MinorityTeacher$ | 0.041 | 0.035 | 0.139 | 0.007 | -0.003 |
| | (0.072) | (0.069) | (0.140) | (0.081) | (0.080) |
| Observations | 25,990 | 25,660 | 25,970 | 25,970 | 25,960 |
| | Persistent | Organized | Adapt | Independent | |
| $MinorityStudent \times MinorityTeacher$ | -0.116 | 0.060 | 0.040 | 0.127 | |
| | (0.088) | (0.093) | (0.093) | (0.085) | |
| Observations | 25,930 | 25,890 | 25,900 | 26,000 | |

NOTE: Each cell is a separate regression of outcomes on the racial/ethnic interactions, conditioning on student characteristics, teacher and student fixed effects. Standard errors are clustered at the teacher and student level. Student controls include student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year. Sample size is rounded to the nearest ten. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

[13] The specification in Panel D is a teacher fixed effects regression, where the coefficient on the interaction captures the impact of the racial/ethnic interactions during the first grade between teachers and students on the first-grade teacher-reported relationship scale with students.

**Table A4:** Estimated Role of Minority Teachers for Student Cognitive Ability

| | (1) | (2) | (3) |
|---|---|---|---|
| | Math Score | Reading Score | Card Sort |
| $MinorityStudent \times MinorityTeacher$ | 0.057 | 0.020 | -0.094 |
| | (0.048) | (0.050) | (0.113) |
| Observations | 26,060 | 26,080 | 26,040 |
| | Number Reverse | Math Evaluation | Reading Evaluation |
| $MinorityStudent \times MinorityTeacher$ | 0.030 | 0.056 | 0.116 |
| | (0.094) | (0.067) | (0.072) |
| Observations | 26,070 | 25,890 | 25,930 |

NOTE: Each cell is a separate regression of outcomes on the racial/ethnic interactions, conditioning on student characteristics, teacher and student fixed effects. Standard errors are clustered at the teacher and student level. Student controls include student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year. Sample size is rounded to the nearest ten. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

**Table A5:** Test of Discrimination 2

| | Teacher Race/Ethnicity | | | | Teacher Race/Ethnicity | | |
|---|---|---|---|---|---|---|---|
| | White | Minority | P-Value | | White | Minority | P-Value |
| Student Race/ Ethnicity | **Closeness** | | | | **Positiveness** | | |
| White | 0.145 | 0.070 | 0.02 | White | 0.092 | 0.013 | 0.02 |
| | (0.926) | (0.970) | | | (0.954) | (0.998) | |
| Observations | 15,170 | 660 | | Observations | 15,020 | 660 | |
| Minority | -0.051 | -0.152 | <0.001 | Minority | -0.107 | -0.203 | <0.001 |
| | (1.010) | (1.050) | | | (1.034) | (1.081) | |
| Observations | 6,740 | 3,410 | | Observations | 6,660 | 3,320 | |

NOTE: Standard errors of the means are in parentheses. Sample size is rounded to the nearest ten

**Table A6:** Test of Discrimination 3

| | Teacher Race/Ethnicity | | | | Teacher Race/Ethnicity | | |
|---|---|---|---|---|---|---|---|
| | White | Minority | P-Value | | White | Minority | P-Value |
| Student Race/ Ethnicity | **Residualized Closeness** | | | | **Residualized Positiveness** | | |
| White | 0.003 | -0.071 | 0.02 | White | 0.003 | -0.074 | 0.02 |
| | (0.926) | (0.970) | | | (0.954) | (0.999) | |
| Observations | 15,170 | 660 | | Observations | 15,020 | 660 | |
| Minority | 0.033 | -0.065 | <0.001 | Minority | 0.031 | -0.061 | <0.001 |
| | (1.005) | (1.050) | | | (1.034) | (1.081) | |
| Observations | 6,740 | 3,410 | | Observations | 6,660 | 3,320 | |

NOTE: Standard errors of the means are in parentheses. Sample size is rounded to the nearest ten

**Table A7:** Estimated Role of Minority Teacher for Teacher-Student Relationships, Group Regressions

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Closeness | Conflict | Positiveness | Negativeness |
| **Panel A: Minority Students** | | | | |
| *OppositeRace* | -0.056 | 0.096*** | -0.077* | 0.100*** |
| | (0.038) | (0.032) | (0.041) | (0.033) |
| Observations | 7,050 | 7,050 | 6,950 | 6,930 |
| **Panel B: White Students** | | | | |
| *OppositeRace* | 0.024 | -0.003 | 0.037 | -0.0005 |
| | (0.055) | (0.045) | (0.057) | (0.046) |
| Observations | 10,740 | 10,740 | 10,620 | 10,590 |

NOTE: Each cell is a regression of relationship outcomes on the *OppositeRace* teacher dummy, conditioning on teacher characteristics and student fixed effects. Student controls include student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year. Teacher characteristics consist of education, gender, whether the teacher is a high-quality teacher based on the state standard, whether teacher took the exam for national board for professional teaching certification standard. The comparison group is own-race teacher. Standard errors clustered at the teacher level are provided in the parentheses. Sample size is rounded to the nearest ten. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

## B Appendix B

We rewrite equation (1) in the main text, ignoring all fixed effects:

$$y_{ijt} = \beta_0 + \beta_1 minoritystudent_i \times minorityteacher_j + \beta_2 minoritystudent_i + \beta_3 minorityteacher_j + \beta_4 X_{it} + \beta_5 T_j + \epsilon_{ijt} \tag{7}$$

The difference in the teacher-student relationship score between a minority and a white student when they are assigned to a white teacher is $\beta_2$. The difference when they are in a minority-taught class is $\beta_1 + \beta_2$. Therefore, switching from a white to a minority teacher increases the difference in the teacher-student relationship scale between minority and white children by $\beta_1$. Let *same* represent the match, i.e., the situation when a minority student is assigned to a minority teacher or a white student is assigned to a white teacher. The dummy variable same takes the value of 1 if a student is matched to a teacher of his/her own type. Let $X(T)$ denote student (teacher) characteristics. Consider the following:

$$y_{ijt} = \alpha_0 + \alpha_1 same_{ij} + \alpha_2 X_{it} + \alpha_3 T_j + \epsilon_{ijt} \tag{8}$$

When a minority student is assigned to a minority teacher, the relationship scale is $\alpha_1$ standard deviations higher than the relationship scale when that student has a white teacher. Similarity, the relationship scale between a white student and his teacher goes down by $\alpha_1$ standard deviations when he switches from a white taught class to a minority taught class. Changing from a white to a minority teacher, the teacher-student relationship scale difference between minority and white children increase by $2\alpha_1$. Let's consider minority and white students separately. For minority students:

$$y_{ijt} = \gamma_0 + \gamma_1 minorityteacher_j + \gamma_2 X_{it} + \gamma 3 T_j + \epsilon_{ijt} \tag{9}$$

changing from a white teacher to a minority teacher improves the student-teacher relationships by $\gamma_1$ standard deviations. For white students:

$$y_{ijt} = \theta_0 + \theta_1 whiteteacher_j + \theta_2 X_{it} + \theta_3 T_j + \epsilon_{ijt} \tag{10}$$

being assigned to a minority-taught class lowers the student-teacher relationship score by $\theta_1$. Therefore, the gap in teacher-student relationship scale between minority and white students goes up by $\gamma_1 + \theta_1$ when they switch from a white to a minority teacher. Therefore, it is true

that $\beta_1 = 2\alpha_1 = \gamma_1 + \theta_1$. Table B2 and B3 verify the results.[14]

**Table B1:** Test of Discrimination 1

| | Closeness | Positiveness |
|---|---|---|
| | (1) | (2) |
| P-value | 0.000 | 0.000 |
| Observations | 17,790 | 17,570 |
| Teacher fixed effects | ✓ | ✓ |

NOTE: This table gives the result from the test of joint significance of the teacher-by-race effects in a regression of relationship outcomes on teacher fixed effects, the interaction between teacher fixed effects and student race.

**Table B2**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Closeness | Conflict | Positiveness | Negativeness |
| **Panel A**: All students | | | | |
| $MinorityStudent \times MinorityTeacher$ | 0.062 | -0.157** | 0.065 | -0.163** |
| | (0.086) | (0.077) | (0.091) | (0.079) |
| **Panel B**: Minority students | | | | |
| $MinorityTeacher$ | 0.072 | -0.111** | 0.095* | -0.109** |
| | (0.049) | (0.044) | (0.053) | (0.045) |
| **Panel C**: White students | | | | |
| $WhiteTeacher$ | -0.012 | -0.048 | -0.029 | -0.057 |
| | (0.072) | (0.063) | (0.076) | (0.065) |

NOTE: Panel A reports the coefficient on the interaction between minority student and minority teacher dummies, controlling for teacher characteristics and student fixed effects. Panel B and C report coefficients on the teacher race, controlling for student fixed effects and teacher characteristics, separately for minority and white students. Teacher characteristics consist of education, gender, whether the teacher is a high-quality teacher based on the state standard, whether teacher took the exam for national board for professional teaching certification standard. Student controls include student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year. Standard errors are clustered at the teacher level. Sample size is rounded to the nearest ten. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

[14] Table B2 and B3 should be considered separately for parallel specifications. Specifically, Table B2 includes only student fixed effects while Table B3 includes both teacher and student fixed effects.

**Table B3**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Closeness | Conflict | Positiveness | Negativeness |
| **Panel A**: All students | | | | |
| $MinorityStudent \times MinorityTeacher$ | 0.288** | -0.039 | 0.323** | -0.032 |
| | (0.125) | (0.131) | (0.138) | (0.135) |
| **Panel B**: All students | | | | |
| *same* | 0.144** | -0.0196 | 0.162** | -0.016 |
| | (0.063) | (0.065) | (0.069) | (0.067) |

NOTE: Panel A reports the coefficient on the interaction between minority student and minority teacher dummies, controlling for teacher fixed effects and student fixed effects. Panel B reports coefficients on the "same" dummy (defined as in the text) controlling for student fixed effects and teacher fixed effects. Student controls include student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year. Standard errors provided in the parentheses are clustered at the teacher and student level. Sample size is rounded to the nearest ten $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

**Table B4:** Alternative Specifications for the Main Results

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **Panel A: Closeness** | | | | | |
| | 0.288** | 0.062 | 0.092 | 0.288** | 0.288** |
| | (0.125) | (0.086) | (0.07) | (0.134) | (0.142) |
| Observations | | | 17,790 | | |
| **Panel B: Conflict** | | | | | |
| | -0.039 | -0.157** | -0.148** | -0.039 | -0.039 |
| | (0.131) | (0.077) | (0.066) | (0.134) | (0.138) |
| Observations | | | 17,790 | | |
| **Panel C: Positiveness** | | | | | |
| | 0.323** | 0.065 | 0.1 | 0.323** | 0.323** |
| | (0.138) | (0.091) | (0.073) | (0.150) | (0.158) |
| Observations | | | 17,570 | | |
| **Panel D: Negativeness** | | | | | |
| | -0.032 | -0.163** | -0.153** | -0.032 | -0.032 |
| | (0.135) | (0.079) | (0.067) | (0.138) | (0.140) |
| Observations | | | 17,520 | | |
| Child fe | ✓ | ✓ | | ✓ | ✓ |
| Teacher fe | ✓ | | | ✓ | ✓ |
| Cluster level | Teacher & Child | Teacher & Child | Teacher & Child | Teacher | School & Child |

NOTE: This table reports the coefficients on the interaction between minority teacher and minority student. Teacher characteristics consist of education, gender, whether the teacher is a high-quality teacher based on the state standard, whether teacher took the exam for national board for professional teaching certification standard. Student controls include student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year, student gender, race, and language spoken at home. Standard errors are provided in the parentheses. Sample size is rounded to the nearest ten. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$