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The Relationship between Race-Congruent Students and Teachers: Does Racial Discrimination Exist?

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Abstract

This paper explores the role of teacher race/ethnicity in the teacher-perceived relationship with early elementary school students. Employing a model with both student and teacher fixed effects, I discover a positive link between the racial/ethnic match and the teacher-reported relationship with students. Specifically, minority students tend to have a closer and more positive relationship 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 relationship with students is not prompted by teachers favoring their own kind or discriminating against opposite-race students. I show that these estimates 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 relationship between young children with 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 large and persistent achievement gap between white and minority students has been a pressing issue in the United States. The test score gap formed in primary school continues to middle and secondary education (Fryer and Levitt 2006), turning into divergent postsecondary outcomes (Arcidiacono et al. 2012) and lifetime earnings (Chetty et al. 2014b). Closing these minority-white achievement gaps is a potentially important factor in creating social equality. One debated policy recommendation is to take into account the classroom dynamics between students and teachers to adjust the achievement gap. Particularly, increasing the representation of minority teachers at all levels of the education system could probably raise academic outcomes for minority students (see, for example, Joint Center for Political Studies 1989; National Commission on Teaching and America's Future 1996; Clewell and Villegas 1998).

The U.S. teacher workforce remains quite racially homogeneous despite the more diverse student body. In the 2011-2012 academic year, 82 percent of the teacher workforce in K-12 public schools consisted of white teachers while 51 percent of students were white. Black and Hispanic students, respectively, accounted for 16 and 24 percent of the student body whereas the fraction of black and Hispanic teachers was 7 and 8 percent (U.S. Department of Education 2016). The lack of minority teachers is likely to impose a number of disadvantages on minority students, the population of which is projected to increase.¹ Disadvantages include restricted exposure to teachers of similar cultures, the lack of role models, or even the possibility of discrimination against minority students.

In this paper, I present the first empirical evidence of the link between the classroom racial/ethnic interaction and teacher-perceived relationship with students and teacher evaluations of student noncognitive development in the early stage of the child's education. I test whether a minority student could have a more positive relationship with his/her teacher, develop better noncognitive, and cognitive skills if he/she is assigned to a minority teacher.² This is an important question since teacher-student relationship, especially in early years, could potentially affect students' current learning motivation, long-term behaviors and academic achievement (Pianta and Nimetz 1991; Hamre and Pianta 2001). I employ the

¹ According to the current population report by the United States Census, 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.

confidential version of the Early Childhood Longitudinal Studies - K: 2011 (ECLS-K:2011) dataset. ECLS-K:2011 allows me to observe the same child from kindergarten through the second grade along with his/her classroom teachers in each grade with detailed demographic information. Besides showing the role of teacher race in the teacher-student relationship scale, this paper disentangles the mechanism behind the racial/ethnic interaction effect. Particularly, I implement the adapted rank-based test of discrimination of 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. A general consensus is the positive effect of such racial/gender interactions in the classroom on students' achievement.³ (see Dee 2007, Bettinger and Long 2005, Hoffmann and Oreopoulos 2009, Carrell et al. 2010 for the effect of teacher gender on students' academic achievement) Extending beyond academic measures, Gong et al. (2018) shows how female teachers could improve noncognitive outcomes among female students. The racial interaction between students and teachers has been documented to generate considerable gains among primary school children (Dee 2004), middle and high school students (Egalite et al. 2015) in terms of test scores, and among college students with regards to course taking, course grades, retention status, degree obtainment (Fairlie et al. 2014, Lusher et al. 2018). Dee (2005) which examines how the racial dynamics influences teacher perception of student performance (frequency of being disruptive, inattentive, and doing homework) is the closest work to this paper. Dee (2005) however, could not disentangle the source of the racial interaction effect - whether the effect stems from the role-model effect (student behavior change) or from teacher bias.

In terms of methodology, I employ a model integrating both the student and the teacher fixed effects to minimize omitted variable bias. 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. I provide evidence against differential sorting from a falsification test which explores the "influence" of racial/ethnic interactions with teachers during the second-grade year on students' outcomes in kindergarten.

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

I detect positive impacts of the racial/ethnic interaction on the teacher-student relationship. Specifically, minority students are likely to have a closer and more positive relationship with the classroom teacher than white students (by 0.288 and 0.323 standard deviations of the closeness and positiveness scores) if the teacher has a minority status. There is no differential impact on teacher evaluations of student noncognitive skills nor student cognitive ability. I show further that effects on the teacher-student relationship 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 either a minority or 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 respectively reported in section 4 and section 5. Section 6 discusses mechanisms and tests of discrimination. Section 7 concludes.

2 Data

2.1 Overview and variables

The analysis is based on the Early Childhood Longitudinal Study, Kindergarten Class of 2010-2011 (ECLS-K:2011). This U.S. based dataset, drawn from many sources such as parent interviews, teacher/school administrator questionnaires, and directly administered assessment tests, consists of a nationally representative sample of children from kindergarten through elementary classes. The data were collected from the spring 2011 (when the majority of children were in kindergarten) to the spring 2013 (when most of them were in second grade).

The data contain both teachers' responses about their perceived relationship with the student and teacher subjective evaluations of the student's learning behaviors and academic ability. The ECLS-K:2011 provides detailed demographic characteristics of both students and teachers such as race, ethnicity, gender. For each child in the sample, I have information about his/her family background such as the socioeconomic status measure, retention status, special accommodation status. The classroom teacher of each ECLS-K:2011 child responded to the teacher questionnaire by filling in teaching qualifications, education, and especially providing evaluations of his/her students in various aspects.

To measure the relationship between teachers and students, I 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} I 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, I construct another two indices - Positiveness and Negativeness using the method proposed by Duflo et al. (2007) and Kling et al. (2007). I respectively compute z-scores for each of the 7 underlying items for Closeness, each of the 8 underlying items for Conflict, take simple average of the z-scores and re-standardize the averages across kindergarten and second-grade years.

Measures of the child's learning behaviors are constructed from teacher evaluations of each of the student, taken from the teacher questionnaire. 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 Additionally, the U.S. Department of Education constructs the Approach-to-Learning score from these 7 items.⁷ I standardize 7 items and the Approach-to-Learning score by questionnaire period so that during each spring semester, those variables have zero mean and unit variance. Besides analyzing each item question

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

⁷ The Approach-to-Learning score, calculated when the teacher responded to at least 4 items, is the simple average of those items.

separately, I, following Duflo et al. (2007) and Kling et al. (2007), take simple average of the z-scores of the item variables and re-standardize the averages, to generate the Learning index.⁸

The final set of outcomes is student cognitive ability, captured by direct assessment tests in math and reading, assessments in executive functions (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) and teacher’s evaluation of each student’s math and reading skill. Teachers were asked to respond 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 in this paper is the racial/ethnic match between students and teachers, therefore, I only keep observations with non-missing race/ethnicity information. I limit the analysis to white - black - Hispanic students and teachers, the three main racial/ethnic groups in the U.S. I only keep students who are in the sample during both kindergarten and the second-grade years. I focus on the kindergarten and second-grade year due to the potential threat of confounding factors during the first grade. Specifically, teacher-student racial/ethnic interactions in the first grade still produces a relatively large “influence” on the teacher-rated teacher-student relationship scale during kindergarten. Although the “effect” is statistically insignificant, its magnitude is quite large. Details are provided in Appendix A.⁹ These restrictions result in 9040 students and 6410 teachers, from a total of 1510 schools.

Summary statistics are provided in table 1. Panel A shows the Student-Teacher Relationship Scale variables. Positiveness and Negativeness are standardized to have zero mean and unit variance. Closeness and Conflict scores, respectively, have mean of 0.053 and -0.012

⁸ The Learning variable is re-standardized across kindergarten and second-grade years

⁹ Including the first grade, however, does not substantially change the result. See Appendix A for more details

of a standard deviation. Teacher subjective evaluations of student learning behaviors are presented in panel B. The short name of each variable used in this analysis is shown in the parentheses. The Approach to Learning (ATL) score has 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.¹⁰ Also included in panel C is the indirect assessment of student cognitive ability - teacher subjective ratings of student math and reading skills.

As shown in panel D, I break down the sample of students and teachers their by race/ethnicity. The majority of students are white (60 %) while the share of Hispanic and black students is 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 my sample is close to the national share of each group in the K-12 teacher workforce.¹¹ It is evident from panel E that despite the more diverse student body, the teacher workforce remains quite racially homogeneous.

3 Empirical Methodology

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

$$y_{ijt} = \beta_0 + \beta_1 \text{minoritystudent}_i \times \text{minorityteacher}_{jt} + \beta_2 X_{it} + \lambda_i + \delta_j + \epsilon_{ijt} \quad (1)$$

where y_{ijt} is the outcome for student i of teacher j in year (grade) t . For this analysis, t includes the kindergarten and the second-grade year. minoritystudent_i takes the value of 1 if student i is either black or Hispanic and 0 otherwise. $\text{minorityteacher}_{jt}$ is an indicator variable which equals 1 if teacher j in year t (kindergarten or second-grade teacher) is either black or Hispanic and 0 otherwise. X_{it} is a vector of observable student characteristics that vary across years, including retention status, special accommodation status, whether the student changes teacher during one academic year. λ_i is student fixed effects and δ_j stands for

¹⁰ 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

¹¹ U.S. Department of Education (2016)

teacher fixed effects, and ϵ_{ijt} is the error term. This specification 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 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. 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 β_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 β_1 indicates minority students receive more favorable outcomes relative to their white peers from being 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, I include only teacher fixed effects, and looking at the impact of the racial/ethnic interactions on teacher-student relationship scores separately in the kindergarten and second-grade year:

$$y_{ij} = \beta_0 + \beta_1 \text{minoritystudent}_i \times \text{minorityteacher}_j + \beta_2 \text{minoritystudent}_i + \beta_3 X_{it} + \delta_j + \epsilon_{ij} \quad (2)$$

Teacher fixed effect is still represented by δ_j . Apart from controls defined in equation (1), X_i in equation (2) also includes student gender, and language spoken at home. The *minoritystudent_i* dummy is added to equation (2).¹² Standard errors in equation (2) are clustered at the teacher level.

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

$$y_{ijt} = \alpha_0 + \alpha_1 \text{same}_{ij} + \alpha_2 X_{it} + \lambda_i + \delta_j + \epsilon_{ijt} \quad (3)$$

¹² I also use specification (2) to estimate the racial/ethnic interaction effects for two years. Specification (2) is only run for the main outcomes of the paper, the teacher-student relationship scale scores.

where $same_{ij}$ takes the value of 1 if there is a racial match and 0 otherwise. With the inclusion of only teacher fixed effects, one can also look at students from each racial/ethnic group (minority vs white) separately. The coefficient on the teacher race dummy captures the similar race effects.¹³

4 Results

4.1 Racial match and the student - teacher relationship scale

Table 2 presents my estimates of the teacher race/ethnicity effect on the teacher-perceived relationship with students. In other words, β_1 , the racial/ethnic interaction, is reported. Panel A shows my preferred specification, i.e. equation (1) - including both student and teacher fixed effects.¹⁴ I 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). In all specifications, there is a positive minority interaction effect on the student - teacher relationship scores. My preferred specification indicates an increase in the difference of the student-teacher relationship scale between minority and white students (i.e. a reduction of the minority gap) when students are exposed to a minority teacher. A minority student, when matched with a minority teacher, receives higher teacher-student positive relationship score (column 3) and teacher-student closeness score (column 1) by 0.323 and 0.288 standard deviations respectively than a white student. These results highlight the importance of the racial/ethnic dynamics between students and teachers in shaping teacher perception of their relationship. The teacher fixed effects specification in panel B shows qualitatively similar results although the point estimates are somewhat smaller (0.18 and 0.179 for Closeness and Positiveness respectively). 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 interaction during kindergarten (coefficient estimates are highly significant and very close to those in the preferred teacher and student fixed effects specification in panel A) but impacts are weaker in the second grade (coefficients are smaller than those in other specifications and are statistically insignificant). Turning to the teacher-reported conflict

¹³ Details are provided in appendix B

¹⁴ This identification strategy which relies on the within teacher within student comparisons is utilized in Dee (2007), Hoffmann and Oreopoulos (2009), Fairlie et al. (2014).

score and the negative relationship score as outcome variables, the coefficient estimate on the racial interaction is negative but is statistically indistinguishable from zero. Therefore, impacts on the possible reduction in the conflict/negative student-teacher relationship remain inconclusive.¹⁵ Although the relationship scores are based on teacher's reporting, these effects can be driven by either teachers favoring one group of students and discriminating the other group (i.e. changes stemming only from teachers), or by students adjusting their manners, therefore, end up being on good terms with their teachers (therefore, their teachers are just reporting what is true of their experience, without any bias).

To investigate further the level at which student-teacher interactions are present, I show estimates from regressions where separate interactions across all detailed racial and ethnic groups are included. Student fixed effects absorb the interaction for one of the student groups (white students in this case); teacher fixed effects absorb the interaction for one of the teacher groups (white teacher in this case). Consequently, I end up with 4 of the 9 race/ethnicity interactions and 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 teacher-student Positiveness score, I find a stronger effect for cross-race/ethnicity interactions. Minority students could have a favorable relationship with minority teachers of a different type.¹⁶ Particularly, a black student tends to have a closer relationship with the classroom teacher than a white student by 0.68 standard deviations of 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 assigned to a black teacher (For Closeness (Positiveness) score, the estimate is 0.485 (0.507) standard deviations). For own-race interaction, although positive impacts are detected between Hispanic students and Hispanic teachers, no such relationship is uncovered between black students and black teachers.

¹⁵ In Appendix table B4, I show various specifications for the outcome teacher-student relationship scale. Column 1 - table B4 is the same as panel A - 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 an insignificant increase in the Closeness score and Positiveness score but a significant decline in the Conflict score and Negativeness Score. In other words, minority students are less likely to have conflicts (negative relationship) with their teachers if their teachers also have a minority status.

¹⁶ Fairlie et al. (2014) also document better outcomes for minority students once matched with minority instructors of a different racial type.

4.2 Racial match and student learning behaviors, student cognitive ability

The estimated role of teacher race for student learning behavior is presented in table 4. The first two columns show the effect on the teacher-reported Approach-to-Learning score and the composite Learning index constructed from the seven items (column 3 through 9). I only present results for the specification incorporating both teacher and student fixed effects. Although the coefficients on the racial/ethnic interaction term for Approach-to-Learning score and the Learning index are positive, there is not enough statistical evidence for the effect on the student learning behaviors to be detected.

Student cognitive ability is measured by direct assessment tests in math and reading, direct assessment test of executive functions and indirect teacher evaluations. In contrast to Dee (2004), I don't find any impact of the racial/ethnic match on young children's cognitive scores. Point estimates are small in magnitude and statistically indistinguishable from zero for all outcomes except the teacher evaluation in reading in table 5. Column 6 of table 5 shows a shrinking white-minority achievement gap by 0.194 standard deviations in reading if students are taught by minority teachers. This narrowing gap is not captured by assessment test performance. In order to shed some light on whether this reflects real gains in reading for minority students, I 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 (result table is not shown). The differential effect from this regression is 0.072. Compared to the actual effect of the racial 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 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. In brief, there is no effect of the racial/ethnic interaction on the academic ability for minority students exposed to minority teachers.

5 Falsification Test

In sum, I find that minority students tend to have a more positive teacher-student relationship 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 relative sorting. In other words, a level of caution should be exerted to interpret this estimated relationship as causal since, for instance, well-behaved minority kids may systematically sort into minority-taught classes while well-behaved white kids do not. Unfortunately, there is no way to directly test for relative sorting. However, I can run a falsification test by examining the "effect" of the 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 status, age, home language), and teacher fixed effects. If there were to be a spurious impact of the racial/ethnic interaction in the classroom on teacher-student relationship, I would see the coefficient estimate on the match in the falsification test statistically distinct from zero.

Table 6 presents the results of the falsification test. The coefficient on the second-grade racial interaction is insignificant and very small (0.02 for Past (kindergarten) Closeness; 0.01 for Past (kindergarten) Positiveness). I also report the p-values which are very high. This indicates there are indeed some positive effects of the racial/ethnic match between teachers and students on the teacher-perceived relationship with students.

6 Mechanisms and Discussion

Now I turn to the explore the mechanisms behind the racial/ethnic interactions above. One key question is whether my estimates are driven by teachers or students behaving differently. Teachers may favor children of their own race and are biased against the opposite-race students (Casteel 1998; Zimmerman et al. 1995; Ferguson 2003). Alternately, students might feel more comfortable, focused, and 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, I execute several tests of discrimination to see if teachers are showing bias against students with a different racial/ethnic identity.¹⁷ First, I run a regression of the teacher-student relationship scale variables (Closeness and Positiveness) on teacher fixed effects and the interaction between teacher effects and student race to test for the joint significance of all coefficients on the interactions. These interaction

¹⁷ Since I only uncover effects on Closeness and Positiveness scores, tests of discrimination are conducted only on these variables.

effects capture the variation in teacher-specific minority-white relationship gaps. Coefficients on these interactions are statistically distinct from zero (table B1 in the appendix), implying there are indeed differences in the way teachers perceive their relationship with minority and white students.

Second, I adapt the rank-based test in Anwar and Fang (2006) to test for taste-based discrimination. Let $\gamma(W, w)$, $\gamma(M, w)$ represent the average relationship scale (Closeness and Positiveness) reported by white and minority teachers with white students. Similarly, $\gamma(W, m)$ ($\gamma(M, m)$) stands for the average relationship scale between white (minority) teachers and minority students. When $\gamma(W, w)$ is greater than $\gamma(M, w)$, white teachers tend to have a more positive relationship with white students than minority teachers. When $\gamma(W, m)$ is larger than $\gamma(M, m)$, it means white teachers are also inclined to provide higher relationship score with minority students than minority teachers. If both conditions hold at the same time:

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

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

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

Results of this test are given in table 7 for the teacher-reported closeness (panel A) and the positive relationship score (panel B). White teachers indeed have higher relationship score (both Closeness and Positiveness) with white students than minority teachers. This is significant at 5% level. I also observe white teachers hold a more positive relationship with minority students than minority teachers ($-0.045 > -0.158$; $-0.101 > -0.211$) and the difference is statistically different from zero. Table 7 supports the conjecture of no racial discrimination from teachers.

There is one caveat in interpreting the results from table 7. The Fang and Anwar (2006) test of discrimination rests on the assumption that white and minority troopers are faced with the same population of white and minority motorists. In my 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, I run a regression of relationship outcomes (both closeness and positiveness) on student race and year fixed effects.¹⁸ The mean residuals from these regressions grouped by the race of teachers and race of students are presented in table 8. White teachers tend to have better relationship with white students than minority teachers ($0.003 > -0.06$; $0.003 > -0.063$) and at the same time, white teachers hold higher relationship score with minority students than minority teachers ($0.036 > -0.072$; $0.035 > -0.071$) and these differences are far from zero. In sum, table 8 also supports the hypothesis of no racial prejudice from teachers.

Results from the three tests of discrimination show that teachers are not biased in their perceived relationship with students; therefore, the estimated link between the racial interactions and the teacher-student relationship scale is attributed to the student side. To put it differently, it is the students who react favorably when they are assigned to teachers sharing their race/ethnicity. The estimates documented in table 2 reflect the relative gain which could potentially be driven by either minority students responding positively to minority teachers or white students reacting adversely. In order to shed more light on the source of this relative gain, I focus on students from each racial group separately (white vs minority students) and run the following specification:

$$y_{ijt} = \beta_1 \textit{OppositeRace}_j + \beta_2 X_{it} + \lambda_i + T_j + \epsilon_{ijt} \quad (6)$$

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, $\textit{OppositeRace}_j$ takes the value of 1 if the teacher is white and 0 otherwise. For white students, $\textit{OppositeRace}_j$ takes the value of 1 if the teacher is minority and 0 otherwise. β_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. λ_i stands for student fixed effects. Vector of student controls, X_{it} , includes student retention status, special education status, socioeconomic measure, whether the student changes teacher during one academic year. Results are shown in table 9. Panel A illustrates minority students' propensity to have more conflict and a more negative relationship with white teachers while it is evident from panel B that the relationship between white students and minority teachers are indifferent from that with white teachers.

¹⁸ This technique is similar to the one in Depew, Eren, and Mocan (2017)

Based on these results, the racial interaction effect is driven by minority students reacting negatively when matched with white teachers but positively when assigned to minority teachers. This behavior of minority students is related to the concept of "in-group favoritism" where individuals coming 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 interaction between in-group members and out-group individuals is documented in Chen and Li (2009), Bernhard et al. (2006) and Mussweiler and Ockenfels (2013) where in-group members are more inclined to punish out-group members for misbehaving, and Levine et al. (2014) which shows members of a racially homogeneous group of traders tend to trust each other's actions in financial markets.

The impact of racial/ethnic interactions on the teacher-student relationship has fundamental policy implications. It is well known that teachers play an important part in student learning and experiences during formal school years (Chetty et al. 2014a), as well as future income (Chetty et al. 2011, Chetty et al. 2014b). Upon school entry, the relationship with teachers becomes crucial to children's classroom adjustment (Lynch and Cicchetti 1992; Pianta et al. 1995; Birch and Ladd 1997). The positive teacher-student relationship generates safe feelings about the learning environment among students as well as facilitates the development of important social and academic skills (Baker et al. 2008, O'Connor et al. 2011). Children who are on good terms with teachers are more motivated to learn as well as find it easier to adapt to the social environment (Entwisle and Hayduk 1988). Pianta and Nimetz (1991) show that improvements in the teacher-student relationship in kindergarten lead to beneficial adjustments of children in later grades. For some students, a positive relationship with teacher serves as a protector from unsupportive families (Cicchetti and Lynch 1993). A negative relationship with teachers, on the other hand, induces school avoidance and lack of cooperation in the classroom (Birch and Ladd, 1997). Early conflicts with teachers leave persistent consequences such as anti-social or aggressive behaviors (Birch and Ladd, 1998). Although the effect on neither students cognitive nor noncognitive ability is uncovered in this paper, it is worth noting that the quality of the teacher-student relationship may not affect current learning and skill formation but has a predictive power in children long-term behavioral and academic outcomes (see for example, Pianta and Nimetz 1991, Hamre and Pianta 2001). If we can get minority children exposed to minority teachers, there will be not only gains in the teacher-student relationship in the short run but also potential improvements in both cognitive and noncognitive measures for minority students in the long run. Because

white students do not change their behavior to either white or minority teachers, increasing the representation of minority teachers is likely to benefit minority children without posing any harm to their white peers.

7 Conclusion

Using the confidential version of the Early Childhood Longitudinal Study K-2011, I provide the first empirical evidence of the causal link between the teacher-student racial/ethnic interaction and teacher-perceived relationship with students in kindergarten and early elementary school. By making within-teacher within-student comparison, the empirical model overcomes most of the endogeneity problem. One potential threat to the internal validity of my estimates lies with relative sorting, which is tentatively shown by a falsification test not to be an issue in my context. I find that minority students tend to have a better relationship with teachers when the teacher is a minority. Specifically, minority students are likely to have a closer relationship with their teachers by 0.288 standard deviations (of the Closeness score) and tend to hold a more positive relationship with their teachers by 0.323 standard deviations (of the Positiveness score) when they are assigned to a minority-taught class. These positive impacts on the teacher-student relationship 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 of learning behaviors, and cognitive ability between white and minority students.

Examining the mechanisms behind the estimated link between racial interactions and teacher-student relationship, I rule out the channel from the teacher to the student by conducting the test of discrimination. Both versions of the adapted rank-based test reveal that teachers are not biased in judging their relationship with their students. This implies that the source of the racial/ethnic interaction effects comes from students behaving differently when they are matched with teachers of different racial/ethnic identities. I am able to show that it is minority students who react adversely when they are assigned to white teachers but white students' behavior remains similar when the teacher is either white or minority. Given the crucial role of the teacher-student relationship in early school years, my results indicate that if we increase the representation of minority teachers in the education system (at least in

the early stage), not only future academic but also future behavioral outcomes for minority students will be improved, helping narrow the white-minority gap.

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Table 1: Summary Statistics

	Mean	SD	Observations
Panel A: Teacher-reported relationship 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	17,740
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

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

	Closeness	Conflict	Positiveness	Negativeness
	(1)	(2)	(3)	(4)
Panel A: Teacher and Student Fixed Effects - Full Sample				
minority_student × minority_teacher	0.288** (0.125)	-0.039 (0.131)	0.323** (0.138)	-0.032 (0.135)
Observations	17,790	17,790	17,570	17,520
Panel B: Teacher Fixed Effects - Full Sample				
minority_student × minority_teacher	0.180** (0.086)	-0.065 (0.103)	0.179** (0.0885)	-0.055 (0.103)
Observations	17,790	17,790	17,570	17,520
Panel C: Teacher fixed effects - Kindergarten				
minority_student × minority_teacher	0.243** (0.098)	-0.003 (0.138)	0.221** (0.101)	0.025 (0.135)
Observations	8,830	8,830	8,710	8,690
Panel D: Teacher Fixed Effects - Second Grade				
minority_student × minority_teacher	0.094 (0.138)	-0.121 (0.139)	0.119 (0.144)	-0.136 (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 clustered at the teacher and student level (Panel A), or at the teacher level (Panel B, C, D) are provided in the parentheses. 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. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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 (0.211)	0.680** (0.277)		0.005 (0.240)	-0.182 (0.275)
Hispanic	0.485** (0.234)	0.341** (0.166)		-0.237 (0.228)	0.01 (0.172)
Positiveness			Negativeness		
Observations	17,570		Observations	17,520	
Black	-0.005 (0.226)	0.749** (0.298)		-0.022 (0.247)	-0.175 (0.273)
Hispanic	0.507** (0.259)	0.384** (0.184)		-0.197 (0.231)	0.029 (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 clustered at the teacher and student level are provided in the parentheses. Sample size is rounded to the nearest ten. *** p<0.01, ** p<0.05, * p<0.1

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

	ATL	Learning	Eagerness	Follow	Attention	Persistent	Organized	Adapt	Independent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
minority_student × minority_teacher	0.079 (0.107)	0.086 (0.114)	0.102 (0.140)	-0.09 (0.123)	-0.012 (0.132)	0.058 (0.127)	0.222 (0.153)	0.036 (0.138)	0.138 (0.132)
Observations	17,780	17,560	17,780	17,780	17,770	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 clustered at the teacher and student level are provided in the parentheses. 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<0.01, ** p<0.05, * p<0.1

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

multicolumn71	Math	Reading	Card	Number	Math	Reading
	Score	Score	Sort	Reverse	Evaluation	Evaluation
	(1)	(2)	(3)	(4)	(5)	(6)
minority_student × minority_teacher	-0.042 (0.08)	-0.0004 (0.101)	-0.066 (0.174)	-0.065 (0.139)	0.037 (0.121)	0.194* (0.111)
Observations	17,880	17,890	17,850	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 clustered at the teacher and student level are provided in the parentheses. 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<0.01, ** p<0.05, * p<0.1

Table 6: Falsification Test

	Past Closeness	Past Conflict	Past Positiveness	Past Negativeness
	(1)	(2)	(3)	(4)
minority_student× minority_teacher	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 clustered at the teacher level are provided in the parentheses. 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<0.01, ** p<0.05, * p<0.1

Table 7: Test of Discrimination 2

	Teacher race			P-Value	Teacher race		
	White	Minority			White	Minority	
Student race	Closeness				Positiveness		
White	0.145 (0.924)	0.083 (1.002)	0.002	White	0.093 (0.955)	0.027 (1.03)	0.08
Observations	10,300	440		Observations	10,190	430	
Minority	-0.045 (1.002)	-0.158 (1.03)	<0.001	Minority	-0.101 (1.03)	-0.211 (1.06)	<0.001
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.

Table 8: Test of Discrimination 3

	Teacher race			P-Value	Teacher race		
	White	Minority			White	Minority	P-Value
Student race	Residualized Closeness				Residualized Positiveness		
White	0.003 (0.924)	-0.06 (1.002)	0.08	White	0.003 (0.956)	-0.063 (1.033)	0.08
Observations	10,300	440		Observations	10,190	430	
Minority	0.036 (1.002)	-0.072 (1.029)	<0.001	Minority	0.035 (1.033)	-0.071 (1.06)	<0.001
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.

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

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

NOTE: Each cell is a regression of relationship outcomes on the Opposite-Race 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. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

A Appendix A

In this appendix A, I provide the estimates using all three years (kindergarten through second grade) to show that the results remain qualitatively similar if the first grade is included. Table A1 presents the effect of the racial interaction on teacher-student relationship scale. The preferred specification (panel A) shows a significant reduction in the teacher-student relationship gap between minority kids and white kids 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 a better relationship 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.

Now I 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 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 have opposite sign to those in table A1. In panel B, the sign of all coefficients is preserved. Looking at the magnitude, having a minority teacher in the first grade improves the student-teacher relationship in kindergarten by 0.05 (0.07) standard deviations 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 percent of the true estimates.¹⁹ 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 (table 6) are only about 8-21 percent of the true estimates (table 2).

For completeness, results on student learning behavior, and cognitive ability are reported in table A3 and A4. Ignoring the potential confounding factors in the first grade, table A5 and A6 present the ranked-based test of racial discrimination (corresponding to table 7-8 in the

¹⁹ 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.

main text). The rank order is preserved, therefore, there is evidence that teachers are not biased in stating their relationship 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 supports the notion that minority students are driving the estimated effect by reacting positively to minority teachers but negatively to white teachers.

In summary, due to the relatively large magnitude of the coefficient in the first-grade falsification regression, I focus on the racial 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 A1: Estimated Role of Minority Teacher for Teacher-Student Relationships

	Closeness	Conflict	Positiveness	Negativeness
	(1)	(2)	(3)	(4)
Panel A: Teacher and Student Fixed Effects - Full Sample				
minority_student × minority_teacher	0.208*** (0.074)	-0.103 (0.072)	0.219*** (0.079)	-0.100 (0.073)
Observations	25,980	25,980	25,660	25,620
Panel B: Teacher Fixed Effects - Full Sample				
minority_student × minority_teacher	0.171** (0.07)	-0.0549 (0.082)	0.172** (0.072)	-0.0505 (0.082)
Observations	25,980	25,980	25,660	25,620
Panel C: Teacher Fixed Effects - Kindergarten				
minority_student × minority_teacher	0.286*** (0.098)	-0.011 (0.142)	0.261*** (0.101)	0.018 (0.139)
Observations	8,570	8,560	8,450	8,430
Panel D: Teacher Fixed Effects First Grade				
minority_student × minority_teacher	0.131 (0.103)	-0.0539 (0.113)	0.134 (0.108)	-0.0605 (0.113)
Observations	8,720	8,720	8,610	8,610
Panel E: Teacher Fixed Effects - Second Grade				
minority_student × minority_teacher	0.066 (0.142)	-0.095 (0.140)	0.095 (0.148)	-0.110 (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. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A2: Falsification Test

	Past Closeness	Past Conflict	Past Positiveness	Past Negativeness
	(1)	(2)	(3)	(4)
Panel A: Second-grade racial/ethnic interaction				
minority_student×minority_teacher	-0.01 (0.139)	0.084 (0.153)	-0.02 (0.145)	0.073 (0.157)
p-value	0.942	0.584	0.891	0.644
Observations	8570	8560	8450	8430
Panel B: First-grade racial/ethnic interaction				
minority_student×minority_teacher	0.05 (0.120)	0.04 (0.133)	0.07 (0.121)	0.08 (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 clustered at the teacher level are provided in the parentheses. 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<0.01, ** p<0.05, * p<0.1

Table A3: Estimated Role of Minority Teacher for Student Learning Behavior

	ATL	Learning	Eagerness	Follow	Attention	Persistent	Organized	Adapt	Independent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
minority_student × minority_teacher	0.041 (0.072)	0.035 (0.069)	0.139 (0.084)	0.007 (0.081)	-0.003 (0.08)	-0.116 (0.088)	0.06 (0.093)	0.04 (0.093)	0.127 (0.085)
Observations	25,990	25,660	25,970	25,970	25,960	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 clustered at the teacher and student level are provided in the parentheses. 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<0.01, ** p<0.05, * p<0.1

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

	Math Score	Reading Score	Card Sort	Number Reverse	Math Evaluation	Reading Evaluation
	(1)	(2)	(3)	(4)	(5)	(6)
minority_student × minority_teacher	0.057 (0.048)	0.02 (0.05)	-0.094 (0.113)	0.03 (0.094)	0.056 (0.067)	0.116 (0.072)
Observations	26,060	26,080	26,040	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 clustered at the teacher and student level are provided in the parentheses. 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<0.01, ** p<0.05, * p<0.1

Table A5: Test of Discrimination 2

	Teacher race				Teacher race		
	White	Minority	P-Value		White	Minority	P-Value
Student race	Closeness			Positiveness			
White	0.145 (0.926)	0.07 (0.97)	0.02	White	0.092 (0.954)	0.013 (0.998)	0.02
Observations	15,170	660		Observations	15,020	660	
Minority	-0.051 (1.01)	-0.152 (1.05)	<0.001	Minority	-0.107 (1.034)	-0.203 (1.081)	<0.001
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				Teacher race		
	White	Minority	P-Value		White	Minority	P-Value
Student race	Residualized Closeness			Residualized Positiveness			
White	0.003 (0.926)	-0.071 (0.97)	0.02	White	0.003 (0.954)	-0.074 (0.999)	0.02
Observations	15,170	660		Observations	15,020	660	
Minority	0.033 (1.005)	-0.065 (1.05)	<0.001	Minority	0.031 (1.034)	-0.061 (1.081)	<0.001
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

	Closeness	Conflict	Positiveness	Negativeness
	(1)	(2)	(3)	(4)
Panel A: Minority Students				
OppositeRace	-0.056 (0.038)	0.096*** (0.032)	-0.077* (0.041)	0.1*** (0.033)
Observations	7,050	7,050	6,950	6,930
Panel B: White Students				
OppositeRace	0.024 (0.055)	-0.003 (0.045)	0.037 (0.057)	-0.0005 (0.046)
Observations	10,740	10,740	10,620	10,590

NOTE: Each cell is a regression of relationship outcomes on the Opposite-Race 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. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

B Appendix B

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

$$y_{ijt} = \beta_0 + \beta_1 \text{minoritystudent}_i \times \text{minorityteacher}_j + \beta_2 \text{minoritystudent}_i + \beta_3 \text{minorityteacher}_j + \beta_4 X_{it} + \beta_5 T_j + \epsilon_{ijt} \quad (7)$$

The difference in the teacher-student relationship score between a minority and a white kid when they are assigned to a white teacher is β_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 β_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:

$$y_{ijt} = \alpha_0 + \alpha_1 \text{same}_{ij} + \alpha_2 X_{it} + \alpha_3 T_j + \epsilon_{ijt} \quad (8)$$

When a minority student is assigned to a minority teacher, the relationship scale is α_1 standard deviations higher than the relationship scale when that student has a white teacher. Similarly, the relationship scale between a white student and his teacher goes down by α_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:

$$y_{ijt} = \gamma_0 + \gamma_1 \text{minorityteacher}_j + \gamma_2 X_{it} + \gamma_3 T_j + \epsilon_{ijt} \quad (9)$$

changing from a white teacher to a minority teacher improves the student-teacher relationship by γ_1 standard deviations. For white students:

$$y_{ijt} = \theta_0 + \theta_1 \text{whiteteacher}_j + \theta_2 X_{it} + \theta_3 T_j + \epsilon_{ijt} \quad (10)$$

being assigned to a minority-taught class lowers the student-teacher relationship score by θ_1 . Therefore, the gap in teacher-student relationship scale between minority and white kids 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.²⁰

²⁰ B2 and B3 should be considered separately for parallel specifications. Specifically, B2 includes only student fixed effects while B3 includes both teacher and student fixed effects.

Table B1: Test of Discrimination 1

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

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. *** p<0.01, ** p<0.05, * p<0.1

Table B2

	Closeness	Conflict	Positiveness	Negativeness
	(1)	(2)	(3)	(4)
Panel A: All students				
minority_student × minority_teacher	0.062 (0.086)	-0.157** (0.077)	0.065 (0.091)	-0.163** (0.079)
Panel B: Minority students				
minority_teacher	0.072 (0.049)	-0.111** (0.044)	0.095* (0.053)	-0.109** (0.045)
Panel C: White students				
white_teacher	-0.012 (0.072)	-0.048 (0.063)	-0.029 (0.076)	-0.057 (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 provided in the parentheses are clustered at the teacher level. Sample size is rounded to the nearest ten. *** p<0.01, ** p<0.05, * p<0.1

Table B3

	Closeness	Conflict	Positiveness	Negativeness
	(1)	(2)	(3)	(4)
Panel A: All students				
minority_student×minority_teacher	0.288** (0.125)	-0.039 (0.131)	0.323** (0.138)	-0.032 (0.135)
Panel B: All students				
same	0.144** (0.063)	-0.0196 (0.065)	0.162** (0.069)	-0.016 (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<0.01, ** p<0.05, * p<0.1

Table B4: Alternative Specifications for the Main Results

	(1)	(2)	(3)	(4)	(5)
Panel A: Closeness					
	0.288** (0.125)	0.062 (0.086)	0.092 (0.07)	0.288** (0.134)	0.288** (0.142)
Observations			17,790		
Panel B: Conflict					
	-0.039 (0.131)	-0.157** (0.077)	-0.148** (0.066)	-0.039 (0.134)	-0.039 (0.138)
Observations			17,790		
Panel C: Positiveness					
	0.323** (0.138)	0.065 (0.091)	0.1 (0.073)	0.323** (0.150)	0.323** (0.158)
Observations			17,570		
Panel D: Negativeness					
	-0.032 (0.135)	-0.163** (0.079)	-0.153** (0.067)	-0.032 (0.138)	-0.032 (0.140)
Observations			17,520		
Child fe	Yes	Yes	No	Yes	Yes
Teacher fe	Yes	No	No	Yes	Yes
Cluster level	Teacher and child	Teacher and child	Teacher and child	Teacher Teacher	School and child

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<0.01, ** p<0.05, * p<0.1