NBER WORKING PAPER SERIES

TAS LIKE ME: RACIAL INTERACTIONS BETWEEN GRADUATE TEACHING ASSISTANTS AND UNDERGRADUATES

Lester Lusher
Doug Campbell
Scott Carrell

Working Paper 21568
http://www.nber.org/papers/w21568

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
September 2015

Special thanks to seminar participants at UC Davis for helpful comments and suggestions. We also want to thank Marco for help with acquiring the data. Lastly, we want to thank the many research assistants who helped carry out the experiments: Nicholas Halliwell, Anthony Lee, Bhaverpreet Sidhu, Hongsik Woo, Catherine Jiang, Logan Schultheis, Shannon Tran, Yulia Zhestkova, Viacheslav Savitskiy, Nadezhda Kotova, and Zalina Alborova. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

TAs Like Me: Racial Interactions between Graduate Teaching Assistants and Undergraduates
Lester Lusher, Doug Campbell, and Scott Carrell
NBER Working Paper No. 21568
September 2015
JEL No. I2,I23

ABSTRACT

Over the past 40 years, higher education institutions in the U.S. have experienced a dramatic shift in the racial composition of students enrolled in both undergraduate and graduate programs. Using administrative data from a large, diverse university in California, we identify the extent to which the academic outcomes of undergraduates are affected by the race/ethnicity of their graduate student teaching assistants (TAs). To overcome selection issues in course taking, we exploit the timing of TA assignments, which occur after students enroll in a course, and we estimate models with both class and student fixed effects. Results show a positive and significant increase in course grades when students are assigned TAs of a similar race/ethnicity. These effects are largest in classes where TAs are given advanced copies of exams and when exams had no multiple choice questions. We also find that assignment to similar race TAs positively affect both section and office hour attendance, suggesting that TA-student match quality and role model effects are the primary drivers of the results.

Lester Lusher
Department of Economics
University of California, Davis
One Shields Avenue
Davis, CA 95616
lrlusher@ucdavis.edu

Scott Carrell
Department of Economics
University of California, Davis
One Shields Avenue
Davis, CA 95616
and NBER
secarrell@ucdavis.edu

Doug Campbell
New Economic School
100 Novaya Street
Skolkovo
Moscow, Russia 143025
dolcampb@gmail.com

1 Introduction

From 1995 to 2012, the United States has steadily fallen relative to other developed countries in college completion rates. Over this short period of time, the US went from having the highest young-adult college completion rate among OECD countries to nineteenth.[1] Especially alarming is the fact that US college completion rates have stagnated *despite* increases in overall college attendance (Turner, 2004; Pew Research Center 2014) and large increases in the returns to a college education in the US (e.g. Goldin and Katz, 2009). Educational mobility in the US also trails the majority of other OECD countries. For example, in the US approximately 29% of men and 17% of women have less education than their parents, compared to the OECD averages of 19% and 13% of men and women, respectively.[2] Underlining these college completion rates are prominent racial gaps (Fry, 2002; Arcidiacono et al., 2011). In 2009, over 50% of Asian adults aged 25 and older held a bachelor's degree or higher compared to less than 20% of African-Americans and Hispanics (Current Population Survey 2009). Such differences in postsecondary educational attainment could lead to persistent income inequality across racial groups (Altonji and Blank, 1999; Card, 1999; Jencks and Phillips, 1998).

A natural question to ask is, once students enter college, what factors determine the likelihood they succeed and graduate? Several prior studies have presented causal evidence on various university inputs that influence undergraduate success, including capacity constraints and resources (Bound et al., 2010; Bound et al., 2012), professor quality, gender, and race (Hoffmann and Oreopoulos, 2009b; Carrell and West, 2010; Hoffmann and Oreopoulos, 2009a; Carrell et al., 2010; Fairlie et al., 2014), coaching and advising (Bettinger and Baker, 2014; Angrist et al., 2009), and academic probation (Lindo et al., 2010).

One glaring omission from this literature centers on teaching assistants (TAs), who account for nearly 15% of the total employment of postsecondary teachers in the US annually

[1] OECD (2014), Education at a Glance 2014, Chart A3.2. Twenty-eight member countries in 2012 were considered for the study.

[2] *http://www.businessinsider.com/r-us-falls-behind-in-college-competition-oecd-2014-9*

(Bureau of Labor Statistics, OES). TAs are graduate students employed by a university who perform various duties in the course while under the supervision of a professor or lecturer. Many of these duties likely impact student success in the course, including: 1) hosting small weekly discussion sections; 2) holding office hours; 3) tutoring; 4) proctoring exams; 5) grading assignments and exams; and 6) arranging other meetings with students. TA-student relationships are unique in that they are more likely to be a peer-based interaction, since the typical age gap between undergraduates and TAs is relatively small.[3] Additionally, with class sizes and student-professor ratios increasing in the US (Cuseo, 2007; Kokkelenberg et al., 2008; Schanzenbach, 2014), TAs are likely to play an increasingly important role in the US post-secondary education system.

In this paper, we begin to shed light on the importance of TAs in the education production process. To do so, we focus on the role of TA race. Understanding how TA race influences student outcomes is particularly important given recent trends in the US. For the past 40 years, undergraduate and graduate programs have been experiencing a dramatic shift in student racial composition. In 1976, 82% of students enrolled in undergraduate programs in the US were White, compared to only 57% in 2013. A similar pattern can be observed in post-baccalaureate programs, where the fraction of non-White students grew by 180% from 1976 to 2013 (NCES 2014).

Why might students be influenced by TA race? Role model effects are often mentioned as an important determinant affecting educational outcomes. Another factor might include racial differences in the academic expectation of the student. Research from psychology and sociology suggests that equally skilled students of different races may perform differently due to the students' self-belief about their ability to succeed, and these gaps may be muted (or exacerbated) by the TA's race (Spencer et al., 1999). Another channel is a match quality effect, where TAs of different races may have, on average, particular teaching styles or

[3]Several studies have focused on the potential benefits of peer-based mentoring and tutoring. For example, Castleman and Page (2014) find that near-aged peer mentors in college who sent text messages during the summer to college-intending high school graduates substantially increased subsequent college enrollment.

capabilities which are better suited to students of similar race.[4] Finally, TAs may exhibit bias with respect to how they treat, consciously or subconsciously, students of a similar race.

Several studies have investigated the importance of race and gender interactions between students and their teachers. A majority of these studies are at the primary and secondary school levels, and show mixed evidence of such interactions (e.g. Ehrenberg et al., 1995; Nixon and Robinson, 1999; Lahelma, 2000; Saft and Pianta, 2001; Dee, 2004; Dee, 2005; Dee, 2007; Carrington et al., 2005; Carrington et al., 2008; Holmlund and Sund, 2008; Lavy and Schlosser, 2011; Winters et al., 2013). Fewer studies have evaluated teacher-student interactions at the postsecondary level, with a majority of studies focusing on professor gender. Results from early studies found mixed results, though these studies likely suffer from potential selection biases (e.g. Rothstein, 1994; Canes and Rosen, 1995; Neumark and Gardecki, 1998). More recent studies, which have exploited within class and within student variation to overcome selection issues have found positive same-gender effects on course grades, choice of major, course credits, and course dropping (Bettinger and Long (2005); Hoffmann and Oreopoulos (2009a); Hoffmann and Oreopoulos (2009b)). Likewise, using random assignment to courses Carrell et al. (2010) find that professor gender has a significant impact on female students' performance in STEM courses. Finally, most closely related to our study, Fairlie et al. (2014) focus on student-instructor race interactions at the community college level and find that race interactions play a large role in student outcomes.

To our knowledge, this is the first study to investigate the importance of TA-student race interactions.[5] Our primary analyses come from detailed student administrative data from a public university in California, coupled with TA assignment data from the university's Department of Economics. The institution we study is large and racially-diverse. In 2014, of the over 34,000 students enrolled, 39% were Asian or Pacific Islander, 19% were Hispanic,

[4]This channel includes language matching where all else equal, a student learns more if particular material can be taught in the student's native language, and students who share the same race as their TAs are more likely to share the same native language.

[5]One exception is a study by Borjas (2000) who examined selection into course sections with foreign-born TAs across three introductory economics courses.

and 29% were White. Our data also include a survey that was offered to all professors who taught an economics class during the period of our study, which asked about exam structure (multiple choice vs. essay) and whether exams were shared with TAs prior to the exam date. Lastly, our data include an audit study conducted during the 2014-15 school year, which recorded student attendance during optional TA discussion sections and office hours.

We consider several empirical strategies to causally identify the effects of TA-student racial interactions and to overcome concerns of potential selection bias. Our primary analyses focus on models with class fixed effects, where we estimate differences in outcome variables between students across different races when assigned to the same TAs within the same class.[6] Since the explanatory variable varies both within class, across students, and within student, across classes, the data also allow us to control for sorting that occurs across classes by simultaneously including student fixed effects and class fixed effects. This two-way fixed effect specification helps mitigate potential omitted variables bias. Still, a selection bias would arise in our setting if, for example, high ability students of particular races systemically enroll in classes with TAs of the same races. We find no evidence of endogenous sorting into classes by student race when predicting the race of the class' TAs with a full set of controls, including professor race and gender, student gender, high school GPA, age, class standing, and major. The lack of evidence of endogenous sorting is unsurprising since undergraduates in our setting have very little ability to identify which classes TAs are assigned to prior to enrolling in the class. Furthermore, the primary registration period for undergraduates occurs before TAs assignments are made by the economics department.[7]

We find that students perform better in classes taken with TAs who are of a similar race. We predict a 7.7% of a standard deviation increase in course grade for students who are assigned to TAs of similar race, relative to being assigned to TAs of dissimilar race.

[6] We define class as a combination of a course (e.g. Introductory Microeconomics), term (e.g. Fall 2010), and lecture. For popular courses, several lectures may be offered within the same term such that each lecture constitutes a different class. TAs are assigned to a single class within a term.

[7] While undergraduates still have the ability to register for courses after the end of the primary registration period, the majority of classes fill up by the time this period is over, leaving little capacity for students to be selective with their courses.

This result is robust across various specifications, racial categorizations, and subsamples. Race interactions have no impact on course withdrawal rates or likelihood of enrolling in subsequent courses in the same field.

Finally, we use the audit study and professor survey to offer evidence of the mechanisms driving the results. Identification of potential mechanisms is largely missing in the previous literature on racial interactions. Results show that students are more likely to attend their TAs' optional discussion sections and office hours when the TA is of a similar race, providing direct evidence of students responding to similarly-raced TAs. We also see that racial interaction effects are especially prominent in classes where TAs had been given a copy of the exam prior to the exam date. We interpret this result as evidence of "teaching to the exam", where TAs divulge information that is pertinent to the class' exams if given the opportunity. Students who are more likely to interact with the TAs by attending the TAs' discussion sections and office hours are the beneficiaries of teaching to the test. Lastly, racial interaction effects are strongest in classes which had no multiple choice on the exams. This result could stem from several possible explanations. First, critical thinking is typically a key component to success on essay-based questions, and critical thinking skills may be fostered in settings where students discuss and ask questions about the course material, such as in TA discussion sections and office hours. Another explanation suggests that TAs are (subconsciously) responding to students of similar race through grading. Classes with no multiple choice exams are classes where TAs have to exercise more subjective judgments when grading, and students of specific races may be more likely to answer non-multiple choice questions in a manner which TAs of similar race favor.

The remainder of this paper proceeds as follows. Section 2 introduces the data. Section 3 discusses our identification strategies and econometric specifications. Section 4 presents our results, and section 5 concludes.

2 Data

2.1 Data Sources and Institutional Background

Our paper centers on detailed student administrative data from a large, public university in California with a highly diversified student community. In 2014, over 34,000 students enrolled at the university, where 39% of the enrolled students were Asian or Pacific Islander, 19% were Hispanic, and 29% were White. U.S. News & World Report (2015) classifies the university admissions as "most selective" and ranks the university as one of the best public university in the United States. Our primary analyses link the student administrative data to graduate teaching assistant (TA) assignment data from the university's economics department. The B.A. in Economics is the second largest major at the university, accounting for over 6% of degrees conferred annually. These data cover the academic school years from 2003 to 2011 for the three primary quarters of enrollment: Fall, Winter, and Spring.[8]

Each observation in our data set pertains to a student who enrolls in a class. We define a class as a combination of a course (e.g. ECN100), a term (e.g. Fall 2010), and a lecture. For popular courses, multiple lectures are often offered within the same term, with different TAs assigned to each lecture (and quite often, different professors). We have a series of student-level characteristics, including term admitted, major(s), admission basis (freshman vs. transfer), gender, race, nationality, parental education, and high school GPA. Student-by-term level variables include academic standing (Freshman/Sophomore/Junior/Senior) and age. Finally, class-level controls include professor gender and race. We match each student by class observation to TAs assigned to the class. Since a single class may contain up to three TAs, we do not necessarily analyze one-to-one matches between a student and a TA.[9] Consequently, as described in further detail in section 3, we link the race of a student enrolled in a class to the racial composition of the TAs assigned to the class.

[8] Hence, we do not focus on any special quarters, such as summer sessions.

[9] In economics courses, a student is technically assigned to a single TA, but often has the liberty to choose any of the TAs in their class to attend discussion sections, visit office hours, etc. Furthermore, it is the joint responsibility of all TAs within a class to assist with lectures, grade assignments and exams, etc.

Lastly, our paper utilizes two supplemental sets of data. First, in the Fall of 2014, we administered a survey that was offered to all professors who taught a class during our 2003 to 2011 time frame. For each class a professor taught, the survey recorded whether the professor shared a copy of the class' exams with the TAs prior to the exam date and the structure of the exams (multiple choice vs. short/long answer). Approximately 58% of our total student-by-class observations are covered by professor survey responses. Secondly, in the Spring 2015 quarter, we conducted an audit study where student attendance by gender and race at TA discussion sections and office hours was recorded by an undergraduate research assistant who audited the class. TA discussion sections and office hours are hosted weekly throughout the quarter, and attendance in our setting is optional for enrolled students. Auditors visited the TA discussion sections during the third and fourth weeks of the term and the office hours during the fifth and sixth weeks. The audit study covers 124 discussion sections and 102 office hours.

2.2 Summary Statistics

The main part of our analysis focuses on two outcome variables at the student-by-class level: whether the student withdrew from the class ("Dropped Class") and the grade received in the class, conditional on completing the course ("Standardized Grade"). We define a student as dropping the class if the student did not receive a letter grade (A through F with +/- modifiers), an "Incomplete" grade, or a "(No) Pass" grade in the class. "Dropped Class" is a binary variable. In order to account for differences in difficulty or grading standards across courses and terms, "Standardized Grade" is standardized to have a mean of zero and a standard deviation of one by class. Other outcomes we save for the appendix include indicators for whether the student passed the class and whether the student enrolled in a class in the same subject in a subsequent term. Table 1 presents summary statistics for our main sample of interest. We have 60,642 student-by-class observations, 19,522 students, 614 classes, and 286 teaching assistants. We define a student or a TA as of Asian race if their primary race is recorded as Chinese, Japanese, Korean, Filippino, South-East Asian,

Vietnamese, Thai, or "Other Asian".

3 Econometric Specifications

Our first specification estimates the impact of TA race for Asian and non-Asian student subsamples separately, using the following specification:

$$y_{ikt} = \gamma SameRaceTA_{ikt} + \beta X_{ikt} + \lambda_k + \alpha_t + u_{ikt} \tag{1}$$

where y_{ikt} is an outcome for student i taking course k in school term t, X_{ikt} is a vector of student by class controls, λ_k and α_t are fixed effects for course and term, respectively, and u_{ikt} is the error term. $SameRaceTA_{ikt}$ is the fraction of student i's TAs for course k in school term t that are of similar race to the student. In other words, if student i is (non-)Asian, then $SameRaceTA_{ikt}$ is the fraction of the student's TAs in course k and term t that are (non-)Asian. Since the number of TAs assigned to a class ranges from one to three, $SameRaceTA_{ikt}$ carries a value of either 0, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, or 1. The estimated γ coefficients measure the average effect from taking a class in which all TAs are of a similar race versus all TAs of a different race, and captures both the racial interaction effect and a TA quality effect (if Asian TAs teach differently than non-Asian TAs, for example). The summation of the γ coefficients for the subsamples captures the interaction effect of a student being of similar race as their TAs (see Appendix).

The data also allow us to run the following specification, using class fixed effects:

$$y_{ikt} = \psi(A_i * AsianTA_{ikt}) + \beta X_{it} + \lambda_{kt} + \alpha_{kA} + \delta_{tA} + u_{ikt} \tag{2}$$

where y_{ikt} is a class-specific outcome for student i, A_i is an indicator variable for whether student i is Asian, $AsianTA_{ikt}$ is the Asian composition of student i's TAs for class kt, X_{it} is a vector of student by term controls, and λ_{kt}, α_{kA}, and δ_{tA} are class, course by race, and term by race fixed effects, respectively. Class fixed effects control for unobserved factors that

vary at the class level and affect student performance. Note that class fixed effects control for professor fixed effects since each class is taught by exactly one professor. These, in turn, control for the possibility that students of a particular race take classes with professors who are systematically different from other professors. Class fixed effects also avoid the need to rely on settings with standardized grading or testing procedures across classes since students within a class are completing the exact same assignments and tests. Thus, we are solely comparing the academic performances of Asian and non-Asian students within the same class and subjecting the students to the same class-level shocks, such as the professor's and TAs' characteristics (e.g. ability/experience) or the time of the class. Course by race fixed effects allow for racial differences in the outcome variable to vary across courses. These are necessary to account for the possibility that the courses in which non-Asians and Asians tend to perform differently are also the courses in which TAs tend to be non-Asian or Asian, respectively.[10] Term by race fixed effects account for the possibility that the academic capabilities of Asian or non-Asian students are changing over time. ψ measures the average outcome gain for Asian students, relative to non-Asian students, from assignment to Asian TAs. Conversely, ψ measures the average outcome loss for non-Asian students, relative to Asian students, from assignment to Asian TAs versus non-Asian TAs.

Finally, to measure student attendance by race to TA discussion sections and office hours from the audit study, we consider the following specification:

$$fracStudentAsian_s = \rho AsianTA_s + \beta X_s + u_s \tag{3}$$

where each observation corresponds to TAs' discussion sections or office hours. X_s comprises of indicators for the weekday, the time, and the individual auditor for the discussion section or office hour.[11] Observations are weighted by total attendance of students to the

[10]For example, Asian students may be more likely to enroll in an international studies course and Asian TAs may be more likely to be assigned to international studies. Indeed, our estimated magnitude of ψ slightly increases when we exclude course by race fixed effects (see Appendix Table A.3).

[11]There were 23 separate auditors who attended the discussion sections and office hours.

discussion section or office hour. ρ is the expected increase in the fraction of attendees who are Asian in response to the discussion section or office hour being hosted by an Asian TA.

3.1 Identification

The primary threat to our identification strategy is potential selection into courses by TA race, which could result in a correlation between the error term u_{ikt} and the interaction term $A_i * AsianTA_{ikt}$ from specification (2). For example, our estimates would be biased if high ability Asian students systemically select into classes assigned Asian TAs and high ability non-Asian students systematically select into classes assigned non-Asian TAs. Prior work looking at professor-student relationships often suffer from such selection biases, where students of a particular gender/race, and different academic capabilities, select into classes based on the teacher gender/race.[12] To mitigate selection biases, previous studies often chose to focus on a sample of students or classes where selection was arguably not an issue.[13] In our setting, it is nearly impossible for undergraduates to identify which TAs are assigned to which classes prior to enrolling in a class. Furthermore, the primary registration period for undergraduates occurs before the department even generates TA assignments for classes.[14] While undergraduates (technically) have the ability to register for courses after the end of the primary registration period, the majority of classes fill up by the time this period is over, leaving little capacity for students to be selective with their courses. As a robustness check, we replace student-level controls in X_{it} with student fixed effects to control for any absolute sorting that takes place if, for instance, students taking classes with Asian TAs are systematically different from those who do not, irrespective of the student's race. Student fixed effects also implicitly control for differences in ability by race that exist across all classes, independent of the TAs' traits.

[12] Perhaps exacerbating selection biases in prior studies are services such as *ratemyprofessor.com*, which provide students with extensive information about their instructors.

[13] For example, Fairlie et al. (2014) focus on students with relatively low standing on registration priority lists since these students have little ability to be selective with their courses.

[14] For example, for the Spring 2014 term, which started in March, the primary undergraduate registration period started on February 3 and ended on February 14. The department of economics generated and privately revealed TA assignments on February 27 to TAs and professors.

We can formally test for endogenous enrollment by race since we have observables X_{ikt} that are correlated with u_{ikt}. In Table 2, we regress $AsianTA_{ikt}$ on observable characteristics and term and course fixed effects. The first column presents results from our main sample of interest, while the next two columns consider Asian and non-Asian student subsamples. The final three columns are laid out in a similar fashion, except they consider the subsample of classes taught by professors who completed the survey. Our regressors are generally small and weak predictors of Asian TA composition, and the race of the student is a very weak predictor of the racial composition of the TAs. For each regression, we test the hypothesis that all covariates are jointly equal to zero, conditional on term and course fixed effects, and report the p-values. Across all samples, we fail to reject the hypothesis that all covariates have no power in predicting TA race.[15] Results from this analysis, coupled with practical knowledge of the selection process for students into classes, indicate that our primary regressor of interest suffers little to no endogeneity bias.

4 Results

4.1 Main Results

Table 3 presents our main results. The first two rows from Table 3 report estimates for γ from specification (1), where we regress our outcome variables on the fraction of TAs who are Asian and non-Asian for Asian and non-Asian student subsamples, respectively. Focusing on the first column, which includes term and course fixed effects, Asian students are about 0.2 percentage points more likely to drop the course when the racial composition of the TAs is entirely Asian, relative to being entirely non-Asian. Non-Asian students are about 0.1 percentage points more likely to drop the course when the class contains all non-Asian TAs. Both of these estimates are small and statistically insignificant. The summation of these two estimates is the expected relative effect between Asian and non-Asian students when

[15] We also consider the "sorting regressions" of Fairlie et al. (2014) in Appendix Table A.1, and find no evidence of endogenous sorting. The primary benefit of the Fairlie et al. (2014) specification is the ability to conditionalize on class fixed effects. A drawback is that one cannot simultaneously test the importance of observables X_{ikt} in predicting TA race.

the student has all Asian TAs instead of all non-Asian TAs. In order to test whether this summation is significant, we ran specification (1) with Asian TA composition on the entire sample while allowing for Asian-specific coefficients for each regressor. Standard errors are clustered by professor for all specifications.[16] An estimate next to "Effect of Similar Race" reports the coefficient from the Asian TA composition variable interacted with an Asian student dummy variable and is equivalent to the summation of the coefficients on the TA racial composition variable from the separate regressions of Asian and non-Asian student subsamples. The second column for each outcome variable includes a full set of controls, while the third column replaces course and term fixed effects with class fixed effects. The final column for each outcome variable replaces student-level controls with student fixed effects. Panel B presents the results for classes where the professor responded to our survey. We find no evidence across all specifications that Asian and non-Asian students differ in their choice to drop a course based on the racial composition of the class' TAs.

Table 3 also suggests that students receive significantly higher grades in response to being assigned TAs of similar race. Interpreting from column (5), we see that Asian students receive a 2.3% of a standard deviation increase in course grade when the racial composition of the TAs is entirely Asian. Similarly, non-Asian students see a 3.7% of a standard deviation increase in course grade when enrolled in a class with all non-Asian TAs. The summation of these two estimates is statistically significant, suggesting that students perform better when taking a class with TAs who are of a similar race as themselves. From our model with both class and student fixed effects, we predict a statistically significant 7.7% of a standard deviation increase in course grade when students are matched to TAs who are all of a similar race as themselves.[17]

[16]With fewer professor clusters than class clusters, we conservatively cluster at the professor level instead of the class level. Ideally, we would cluster at the TA level, but since a single class may contain up to three TAs, a single observation may belong to up to three TA clusters. There are fewer professors than TAs in our setting. As a robustness check, we consider the subsample of classes which had only one TA and cluster at the TA level. Both estimated magnitudes and standard errors slightly increase, with the results remaining largely statistically significant (see Appendix Table A.3, Panel C). The standard errors decrease when we cluster at the class level instead of professor level.

[17]When the data are parsed by White and non-White students and TAs, this coefficient drops slightly to

4.2 Mechanisms

An important question to address for welfare and policy implications centers on the mechanisms that are driving our results. TA race could influence student outcomes in several manners. Role model effects are often mentioned as a determinant affecting educational outcomes, where in our setting, students may be inspired by their TAs, or be more comfortable approaching and learning from their TAs, due to the TA sharing a similar race. Another channel is a match quality effect, where TAs of different race/ethnicity have particular teaching styles which are better suited to students of similar race/ethnicity. Included in this channel is a language matching effect, where students learn more if course material can be explained in the student's native language, and students who share the same race/ethnicity as their TAs are more likely to share a native language. Thus, with a match quality effect, students and TAs are not directly responding to the other's race, but instead students are reacting to a characteristic that is, on average, associated with their TAs' race/ethnicity. Finally, TAs could exhibit bias with respect to how they treat students of a similar race. Discrimination could happen on a subconscious level as well where, for example, TAs of particular races may be more lenient when grading certain types of errors on exams that are more likely to be made by students of similar race. The consequences of each of the three channels provide us with testable hypotheses in order to separately identify the mechanisms behind our results. While we cannot rule out a discrimination effect, the body of evidence presented below suggests that match quality effects and role model effects are the primary drivers for our results.

To start, we test for student response to TA race in the form of student attendance to TA discussion sections and office hours in a setting where attendance is completely optional. Results from specification (3) for the audit study are presented in Table 4. Across all specifications and in both discussion sections and office hours, we find that TA race is

0.076 standard deviations, and maintains statistical significance at the 1% level (see Appendix Table A.5). Racial interactions remain statistically significant when we consider specifications (1) and (2) with finer race categorizations (see Appendix Table A.6 and Table A.7).

positively related to the race of the attending students. From column (3), we predict an 8.4 percentage point increase in the fraction of attending students who are Asian in response to the discussion section being taught by an Asian TA. For office hours, we estimate a 20 percentage point increase in fraction of Asian attendees in response to the office hour being hosted by an Asian TA.[18] These results provide evidence of students directly responding to TAs of similar race. Furthermore, the underlying motive for the students' attendance may be driven by a match quality effect, where a student is learning more from their TAs due to the TAs' teaching styles or capabilities.

Table 5 presents results from the professor survey. We first see that in classes with no multiple choice exams, Asian students see boosts in their grades in response to Asian TAs, while non-Asian students see their grades rise when assigned non-Asian TAs. The estimated racial interaction effect in classes with no multiple choice is 0.217 for the specification with both student and class fixed effects. We observe smaller, statistically insignificant interaction effects when focusing on classes that had exams with multiple choice. One could interpret this finding as suggestive evidence of match-quality effect, where classes with no multiple choice exams may proxy for classes where critical thinking is a key component to student success, and critical thinking skills may be fostered in settings where students discuss and ask questions about the course material, such as in TA discussion sections and office hours. Another explanation, suggesting discrimination, stems from TA grading behavior. Classes with no multiple choice exams likely results in TAs having to exercise more subjective judgments when grading. Students of specific races may be more likely to answer non-multiple choice questions in a manner which TAs of a similar race favor. For example, an essay from an Asian student may be written in a style that is graded more favorably by an Asian TA relative to a non-Asian TA.[19]

[18]The total number of (non-)Asian students who attend discussion sections increases when the TA is (non-) Asian. On the other hand, the total number of office hour attendees decreases, irrespective of student race, in response to office hours being hosted by an Asian TA; the decrease in Asian student attendees is smaller than the decrease from non-Asian student attendees.

[19]This latter example would need to simultaneously apply to both Asian and non-Asian students, since both Asian and non-Asian students see boosts in their grades when matched to TAs of similar race while

Table 5 also suggests that the observed racial interaction effects are especially driven by classes where TAs were given advanced copies of the exam. From column (6), we predict an 11.6% of a standard deviation increase in course grade for Asian students when taking a class with all Asian TAs versus non-Asian TAs. Similarly, non-Asian students see a boost of 3.9% of a standard deviation in course grade in response to taking a class with all non-Asian TAs instead of Asian TAs. Estimated racial interaction effects are statistically significant at the 10% level across all considered specifications. We interpret these results as further reinforcement of a role model effect and TA-student match quality effect. When a TA is given a copy of the exam, the TA has the ability to "teach to the test" by adjusting his/her discussion section and office hour lessons to better suit the material that will appear on the exam. Teaching to the test would benefit students who attend discussion sections and office hours, and as evidenced from the audit study, attending students tend to be of similar race as the TA.[20]

5 Conclusions

In spite of increases in overall attendance, college completion rates have stagnated in the US. A natural question to ask is, once the student enters college, what factors determine student success? The goal of this paper is to shed light on the importance of TAs in the education production process, focusing on the role of TA race. Understanding how TA race influences student outcomes is particularly important given recent trends in the US, where the fraction of non-White undergraduate and graduate students has nearly tripled over the past 40 years. Prominent racial gaps, in turn, lead to persistent income inequality across racial groups.

Our primary analyses come from detailed student administrative data from a public, diverse undergraduate university in California. We consider several empirical strategies to overcome concerns of potential selection bias. We first focus on models with class fixed effects,

taking a class with no multiple choice exams.

[20]The racial interaction effect is strongest in classes that had both shared exams with TAs and no multiple choice (see Appendix Table A.4).

where we compare differences in outcomes between students across different races when assigned to the same TAs within the same class. Furthermore, we simultaneously control for sorting that occurs across classes by including student fixed effects. While selection bias could still arise from this two-way fixed effect specification, we find no evidence of endogenous sorting into classes by student race when predicting the race of the class' TAs with a full set of controls. The lack of sorting is unsurprising since students have very little ability identifying which classes TAs are assigned to, and TA assignments are generated after the undergraduates' primary registration period ends.

We find that students perform better when taking a class with TAs who are of a similar race. Race interactions have no impact on course withdrawal rates or likelihood of enrolling in subsequent courses in the same field. Students are more likely to attend their TA's optional office hours and discussion sections when the TA is of a similar race. Racial interactions are strongest in classes where TAs had been given a copy of the exam prior to the exam date, and when the exams for the class had no multiple choice. The body of evidence suggests that role model effects and match quality effects between TAs and their students play noticeable roles in determining student success.

References

Altonji, J. G. and R. M. Blank (1999). "Race and Gender in the Labor Market." In: *Handbook of Labor Economics* 3, pp. 3143–3259.

Angrist, J., D. Lang and P. Oreopoulos (2009). "Incentives and Services for College Achievement: Evidence from a Randomized Trial." In: *American Economic Journal: Applied Economics*, pp. 136–163.

Arcidiacono, P., S. Khan and J. L. Vigdor (2011). "Representation Versus Assimilation: How do Preferences in College Admissions Affect Social Interactions?" In: *Journal of Public Economics* 95.1, pp. 1–15.

Bettinger, E. P. and R. B. Baker (2014). "The Effects of Student Coaching: An Evaluation of a Randomized Experiment in Student Advising." In: *Educational Evaluation and Policy Analysis* 36.1, pp. 3–19.

Bettinger, E. P. and B. T. Long (2005). "Do Faculty Serve as Role Models? The Impact of Instructor Gender on Female Students." In: *American Economic Review*, pp. 152–157.

Borjas, G. J. (2000). *Foreign-born Teaching Assistants and the Academic Performance of Undergraduates*. Tech. rep. National Bureau of Economic Research.

Bound, J., M. F. Lovenheim and S. Turner (2010). "Why Have College Completion Rates Declined? An Analysis of Changing Student Preparation and Collegiate Resources." In: *American Economic Journal: Applied Economics* 2.3, pp. 129–57.

Bound, J., M. F. Lovenheim and S. Turner (2012). "Increasing Time to Baccalaureate Degree in the United States." In: *Education Finance and Policy* 7.4, pp. 375–424.

Canes, B. J. and H. S. Rosen (1995). "Following in her Footsteps? Faculty Gender Composition and Women's Choices of College Majors." In: *Industrial and Labor Relations Review*, pp. 486–504.

Card, D. (1999). "The Causal Effect of Education on Earnings." In: *Handbook of Labor Economics* 3, pp. 1801–1863.

Carrell, S. E., M. E. Page and J. E. West (2010). "Sex and Science: How Professor Gender Perpetuates the Gender Gap." In: *The Quarterly Journal of Economics* 125.3, pp. 1101–1144.

Carrell, S. E. and J. E. West (2010). "Does Professor Quality Matter? Evidence from Random Assignment of Students to Professors." English. In: *Journal of Political Economy* 118.3, pages.

Carrington, B., P. Tymms and C. Merrell (2005). "Forget Gender: Whether a Teacher is Male or Female Doesn't Matter." In: *Teacher: The National Education Magazine* Dec 2005, p. 32.

Carrington, B., P. Tymms and C. Merrell (2008). "Role Models, School Improvement and the 'Gender Gap'—Do Men Bring out the Best in Boys and Women the Best in Girls?" In: *British Educational Research Journal* 34.3, pp. 315–327.

Castleman, B. L. and L. C. Page (2014). "Summer Nudging: Can Personalized Text Messages and Peer Mentor Outreach Increase College Going Among Low-income High School Graduates?" In: *Journal of Economic Behavior & Organization*.

Cuseo, J. (2007). "The Empirical Case Against Large Class Size: Adverse Effects on the Teaching, Learning, and Retention of First-Year Students." In: *The Journal of Faculty Development* 21.1, pp. 5–21.

Dee, T. S. (2004). "Teachers, Race, and Student Achievement in a Randomized Experiment." In: *Review of Economics and Statistics* 86.1, pp. 195–210.

Dee, T. S. (2005). "A Teacher Like Me: Does Race, Ethnicity, or Gender Matter?" In: *American Economic Review*, pp. 158–165.

Dee, T. S. (2007). "Teachers and the Gender Gaps in Student Achievement." In: *Journal of Human Resources* 42.3, pp. 528–554.

Ehrenberg, R. G., D. Brewer and D. Goldhaber (1995). "Do Teachers' Race, Gender, and Ethnicity Matter? Evidence from the NELS." In: *Industrial and Labor Relations Review* 48.3, pp. 547–561.

Fairlie, R. W., F. Hoffmann and P. Oreopoulos (2014). "A Community College Instructor Like Me: Race and Ethnicity Interactions in the Classroom." In: *American Economic Review* 104.8, pp. 2567–91.

Fry, R. (2002). "Latinos in Higher Education: Many Enroll, Too Few Graduate." In:

Goldin, C. D. and L. F. Katz (2009). *The Race Between Education and Technology*. Harvard University Press.

Hoffmann, F. and P. Oreopoulos (2009). "A Professor Like Me: The Influence of Instructor Gender on College Achievement." In: *Journal of Human Resources* 44.2, pp. 479–494.

Hoffmann, F. and P. Oreopoulos (2009). "Professor Qualities and Student Achievement." In: *The Review of Economics and Statistics* 91.1, pp. 83–92.

Holmlund, H. and K. Sund (2008). "Is the Gender Gap in School Performance Affected by the Sex of the Teacher?" In: *Labour Economics* 15.1, pp. 37–53.

Jencks, C. and M. Phillips (1998). "The Black-White Test Scope Gap: Why It Persists and What Can Be Done." In: *The Brookings Review*, pp. 24–27.

Kokkelenberg, E. C., M. Dillon and S. M. Christy (2008). "The Effects of Class Size on Student Grades at a Public University." In: *Economics of Education Review* 27.2, pp. 221–233.

Lahelma, E. (2000). "Lack of Male Teachers: A Problem for Students or Teachers?" In: *Pedagogy, Culture and Society* 8.2, pp. 173–186.

Lavy, V. and A. Schlosser (2011). "Mechanisms and Impacts of Gender Peer Effects at School." In: *American Economic Journal: Applied Economics*, pp. 1–33.

Lindo, J. M., N. J. Sanders and P. Oreopoulos (2010). "Ability, Gender, and Performance Standards: Evidence from Academic Probation." In: *American Economic Journal: Applied Economics* 2.2, pp. 95–117.

Neumark, D. and R. Gardecki (1998). "Women Helping Women? Role Model and Mentoring Effects on Female Ph. D. Students in Economics." In: *Journal of Human Resources*, pp. 220–246.

Nixon, L. A. and M. D. Robinson (1999). "The Educational Attainment of Young Women: Role Model Effects of Female High School Faculty." In: *Demography* 36.2, pp. 185–194.

Rothstein, D. S. (1994). "Do Female Faculty Influence Female Students' Educational and Labor Market Attainments." In: *Indus. & Lab. Rel. Rev.* 48, p. 515.

Saft, E. W. and R. C. Pianta (2001). "Teachers' Perceptions of Their Relationships with Students: Effects of Child Age, Gender, and Ethnicity of Teachers and Children." In: *School Psychology Quarterly* 16.2, p. 125.

Schanzenbach, D. W. (2014). "Does Class Size Matter?" In: *Policy Briefs, National Education Policy Center, School of Education, University of Colorado, Boulder*.

Spencer, S. J., C. M. Steele and D. M. Quinn (1999). "Stereotype Threat and Women's Math Performance." In: *Journal of Experimental Social Psychology* 35.1, pp. 4–28.

Turner, S. (2004). "Going to College and Finishing College. Explaining Different Educational Outcomes." In: *College Choices: The Economics of Where to Go, When to Go, and How to Pay for it*, pp. 13–62.

Winters, M. A. et al. (2013). "The Effect of Same-gender Teacher Assignment on Student Achievement in the Elementary and Secondary Grades: Evidence from Panel Data." In: *Economics of Education Review* 34, pp. 69–75.

Main Tables

Table 1: Descriptive Statistics

	Mean	SD	Obsevations
Panel A. Sample characteristics, student level			19522
Male	0.528	0.499	
High School Grade Point Average (GPA)	3.641	0.360	
Admitted as transfer	0.201	0.400	
International student	0.039	0.192	
First generation college student	0.388	0.487	
Double major	0.039	0.193	
Panel B. Sample characteristics, class level			614
Number of students registered	117.417	83.147	
Professor White	0.713	0.453	
Professor Asian	0.138	0.346	
	White	Asian	Other/ Minority
Panel C. Student outcomes, student-class level			
Dropped course	0.010	0.010	0.019
Observations: 60,642	(0.100)	(0.100)	(0.135)
Grade	2.552	2.756	2.348
Observations: 57,718	(1.015)	(0.988)	(1.074)
Passed class	0.840	0.877	0.780
Observations: 59,121	(0.367)	(0.329)	(0.414)
Enroll in subsequent class, same field	0.643	0.605	0.608
Observations: 60,642	(0.479)	(0.489)	(0.488)

	Students			Teaching Assistants		
	Mean	SD	Obs.	Mean	SD	Obs.
Panel D. Student and TA shares by race						
White	0.332	0.471		0.378	0.486	
Asian	0.449	0.497	19,522	0.441	0.597	286
Other/Minority	0.219	0.414		0.182	0.386	

Table 2: Falsification Test – Regression of racial composition of TAs on observables

	Full Sample			Prof. Survey Sample		
	All students	Asian	Non-Asian	All	Asian	Non-Asian
Outcome: Fraction TAs Asian						
Asian Student	0.000	—	—	0.002	—	—
	(0.004)	—	—	(0.004)	—	—
Female Student	0.000	0.003	-0.003	-0.001	0.005	-0.006
	(0.003)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)
Admit as Transfer	0.016**	0.023*	0.013	0.011	0.023	0.004
	(0.008)	(0.012)	(0.011)	(0.010)	(0.015)	(0.013)
Age	-0.000	-0.002	0.001	0.000	-0.002	0.002
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
International Student	-0.011	-0.009	-0.014	-0.014	-0.009	-0.030
	(0.010)	(0.010)	(0.018)	(0.010)	(0.011)	(0.021)
First Generation	-0.003	-0.002	-0.004	-0.005	-0.004	-0.006
	(0.003)	(0.004)	(0.004)	(0.003)	(0.005)	(0.005)
High School GPA	0.004	-0.006	0.013**	0.003	-0.000	0.008
	(0.005)	(0.008)	(0.006)	(0.007)	(0.009)	(0.008)
Admission Year	-0.005	-0.004	-0.007	-0.001	-0.003	-0.001
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Same Major as Class	0.000	0.002	-0.003	0.000	-0.000	-0.001
	(0.006)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)
Double Major	0.000	0.001	0.001	0.007	0.005	0.010
	(0.007)	(0.010)	(0.009)	(0.009)	(0.011)	(0.011)
Freshman	0.002	-0.010	0.012	-0.001	-0.015	0.012
	(0.010)	(0.014)	(0.012)	(0.013)	(0.016)	(0.015)
Sophomore	0.008	0.005	0.009	0.002	-0.001	0.007
	(0.007)	(0.010)	(0.010)	(0.010)	(0.012)	(0.012)
Junior	0.001	0.000	0.003	-0.002	-0.010	0.007
	(0.006)	(0.008)	(0.007)	(0.008)	(0.010)	(0.008)
Female Professor	-0.056	-0.057	-0.056	-0.031	-0.047	-0.016
	(0.042)	(0.041)	(0.044)	(0.059)	(0.058)	(0.061)
Asian Professor	0.054	0.046	0.061	0.093	0.081	0.107
	(0.047)	(0.047)	(0.049)	(0.071)	(0.073)	(0.071)
Course & Term FE	Yes	Yes	Yes	Yes	Yes	Yes
P-value: Joint Significance	0.706	0.421	0.389	0.891	0.540	0.592
R-squared	0.220	0.235	0.209	0.306	0.311	0.306
Observations	60642	29391	31251	35023	17448	17575

Notes: Each specification presents results for a regression where the dependent variable is the fraction of the student's TAs in the class that were Asian. Coefficients for term and course FE are not shown. P-value for joint significance of all individual covariates, conditional on term and course FE, included. The first column is our full sample. The next two columns consider Asian and non-Asian student subsamples. The final three columns pertain to the sample of classes taught by professors who participated in our survey. Standard errors in parentheses, clustered by class. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 3: Main Results

	Dropped Class				Standardized Grade			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Full Sample								
Asian Students								
w/ Asian TAs	0.002	0.001	—	—	0.023	0.031**	—	—
	(0.002)	(0.002)	—	—	(0.014)	(0.014)	—	—
Non-Asian Students								
w/ Non-Asian TAs	0.000	0.000	—	—	0.037**	0.045***	—	—
	(0.002)	(0.002)	—	—	(0.014)	(0.014)	—	—
Effect of Similar Race	0.002	0.002	0.002	0.003	0.061**	0.076***	0.078***	0.077***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.026)	(0.024)	(0.025)	(0.019)
Observations	60642	60642	60642	51653	57718	57718	57718	49177
Panel B: Professor Survey Sample								
Asian Students								
w/ Asian TAs	0.001	0.001	—	—	0.036*	0.039**	—	—
	(0.002)	(0.002)	—	—	(0.019)	(0.018)	—	—
Non-Asian Students								
w/ Non-Asian TAs	0.001	0.001	—	—	0.030	0.040*	—	—
	(0.002)	(0.002)	—	—	(0.022)	(0.023)	—	—
Effect of Similar Race	0.003	0.003	0.003	0.005	0.066*	0.079**	0.080**	0.086***
	(0.003)	(0.003)	(0.003)	(0.006)	(0.039)	(0.036)	(0.036)	(0.027)
Observations	35649	35649	35649	30670	33997	33997	33997	29262
Term FE	X	X			X	X		
Course FE	X	X			X	X		
Class FE			X	X			X	X
Student FE				X				X
Controls:								
Professor		X				X		
Student		X	X			X	X	
Student X Term		X	X	X		X	X	X

Notes: Each cell reports the coefficient for similar race graduate TA composition, or in the case of "Effect of Similar Race", Asian graduate TA composition interacted with an Asian student dummy. Standardized grade has a mean of zero and a standard deviation of one by class. Controls include age when class began, high school GPA, and admission year, as well as indicators for student gender, international vs. domestic, whether parents attended college, admittance (transfer vs. freshman), whether the student is majoring in the subject of the course, double major, class standing (Freshman/Sophomore/Junior/Senior), and professor gender and race. All "Effect of Similar Race" specifications include course by race and term by race fixed effects. Standard errors in parentheses, clustered by professor. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 4: Audit Study of TA Section and Office Hour Attendance

	Discussion Section			Office Hours			Pooled	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% students Asian								
Asian TA	0.076**	0.085*	0.084*	0.330***	0.134	0.200*	0.081*	0.081**
	(0.034)	(0.044)	(0.045)	(0.120)	(0.124)	(0.103)	(0.045)	(0.038)
Observations		118			43		161	
Mean of outcome		0.576			0.622		0.588	
Controls		X	X		X	X	X	X
Weighted observations			X			X		X

Notes: Each cell reports the coefficient on an indicator for whether the TA for the discussion section or office hour was Asian. The outcome variable is the fraction of attended students who were Asian. Controls include indicators for weekday, time slot, and auditor. Robust standard errors presented in parenthesis. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 5: Professor Survey Results

	No Multiple Choice Exams				Some/All Multiple Choice			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Outcome: Standardized Grade								
Asian Students								
w/ Asian TAs	0.064**	0.062	—	—	0.044	0.009	—	—
	(0.024)	(0.061)	—	—	(0.030)	(0.034)	—	—
Non-Asian Students								
w/ Non-Asian TAs	0.132***	0.139***	—	—	0.002	0.026	—	—
	(0.024)	(0.046)	—	—	(0.030)	(0.038)	—	—
Effect of Similar Race	0.196***	0.201***	0.199***	0.217***	0.046	0.035	0.046	0.040
	(0.041)	(0.065)	(0.042)	(0.070)	(0.055)	(0.044)	(0.056)	(0.048)
Observations	9185	8883	9185	8883	24290	19861	24290	19861
	Exams Withheld from TAs				Exams Shared with TAs			
Asian Students								
w/ Asian TAs	-0.000	-0.030	—	—	0.081***	0.116*	—	—
	(0.021)	(0.064)	—	—	(0.027)	(0.065)	—	—
Non-Asian Students								
w/ Non-Asian TAs	-0.000	0.105	—	—	0.045	0.039	—	—
	(0.032)	(0.103)	—	—	(0.035)	(0.051)	—	—
Effect of Similar Race	-0.000	0.075	-0.003	0.056	0.126**	0.155*	0.127**	0.172**
	(0.046)	(0.096)	(0.048)	(0.093)	(0.055)	(0.081)	(0.055)	(0.081)
Observations	9189	8296	9189	8296	19119	15503	19119	15503
Term FE	X	X			X	X		
Course FE	X	X			X	X		
Class FE			X	X			X	X
Student FE		X		X		X		X
Controls:								
Professor	X	X			X	X		
Student	X		X		X		X	
Student X Term	X	X	X	X	X	X	X	X

Notes: Each cell reports the coefficient for similar race graduate TA composition, or in the case of "Effect of Similar Race", Asian graduate TA composition interacted with an Asian student dummy. Standardized grade has a mean of zero and a standard deviation of one by class. Controls include age when class began, high school GPA, and admission year, as well as indicators for student gender, international vs. domestic, whether parents attended college, admittance (transfer vs. freshman), whether the student is majoring in the subject of the course, double major, class standing (Freshman/Sophomore/Junior/Senior), and professor gender and race. All "Effect of Similar Race" specifications include course by race and term by race fixed effects. Standard errors in parentheses, clustered by professor. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Results Appendix

Claim: summation of γ coefficients from subsample regressions of equation (1) produces racial interaction effect. Consider the following three regressions:

For Asian students:

$$y_{ikt} = \gamma_1 AsianTA_{ikt} + \beta X_{ikt} + \lambda_k + \alpha_t + u_{ikt} \tag{4}$$

For non-Asian students:

$$y_{ikt} = \gamma_2 AsianTA_{ikt} + \beta X_{ikt} + \lambda_k + \alpha_t + u_{ikt} \tag{5}$$

For non-Asian students:

$$y_{ikt} = \gamma_3 nonAsianTA_{ikt} + \beta X_{ikt} + \lambda_k + \alpha_t + u_{ikt} \tag{6}$$

γ_1 captures both the racial interaction effect and an overall TA quality effect (if, for example, Asian TAs teach differently than non-Asian TAs, on average). The difference between γ_1 and γ_2 is the relative racial difference predicted from assignment to a class with all Asian TAs, and thus captures the interaction effect of a student being of similar race as their TAs. Note that $\gamma_3 = -\gamma_2$. Hence, the summation of γ_1 and γ_3 captures the racial interaction effect. Thus, the summation of the γ coefficients for the subsamples from equation (1) produces the racial interaction effect.

"Sorting Regressions" from Fairlie et al., 2014:

$$\bar{X}_{ac} = \delta_1 AsianTA_c + \delta_2 I_a + \delta_3 AsianTA_c * I_a + v_{ac} \tag{7}$$

Table A.1: Sorting Regressions – Fairlie et al., 2014 (AER)

	Female	High School GPA	Age	Admit as Transfer	# Prior Units	Double Major	International	Class Major
Full Sample	0.014	-0.018	-0.024	0.007	-1.537	-0.014	-0.000	0.003
	(0.018)	(0.014)	(0.061)	(0.015)	(1.924)	(0.018)	(0.012)	(0.017)
Professor Survey Subsample	0.013	-0.001	-0.065	0.008	-1.759	-0.008	0.009	-0.009
	(0.023)	(0.016)	(0.087)	(0.022)	(2.934)	(0.027)	(0.018)	(0.022)
Classes with one TA	0.005	-0.019	-0.060	-0.007	-1.390	-0.011	-0.003	0.002
	(0.024)	(0.019)	(0.071)	(0.020)	(2.424)	(0.024)	(0.016)	(0.021)
Class FE	X	X	X	X	X	X	X	X

Notes: Each cell displays results from a regression of the race-specific average student outcomes in a classroom on an indicator for whether the average is associated with Asian students, the fraction of the TAs assigned to the class who are Asian, the interaction between these two variables, and class fixed effects. This table reports the coefficient on the interaction term, which can be interpreted as the extent to which Asian students sort into classes assigned Asian TAs. Outcomes for each regression vary across columns. Rows are defined by the subsample of students we consider. Students and TAs are classified as Asian if their primary race is recorded as Chinese, Japanese, Korean, Filippino, South-East Asian, Vietnamese, Thai, or "Other Asian". Standard errors in parentheses, clustered by professor. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table A.2: Main Results – More Outcomes

	Passed Class				Enroll in Another Class			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Full Sample								
Asian Students								
w/ Asian TAs	0.003	0.006	—	—	0.012	0.019	—	—
	(0.007)	(0.006)	—	—	(0.018)	(0.016)	—	—
Non-Asian Students								
w/ Non-Asian TAs	0.013*	0.014*	—	—	-0.003	-0.008	—	—
	(0.008)	(0.007)	—	—	(0.013)	(0.013)	—	—
Effect of Similar Race	0.017**	0.020***	0.017**	0.030***	0.009	0.011	0.017	0.004
	(0.007)	(0.007)	(0.007)	(0.008)	(0.016)	(0.015)	(0.017)	(0.025)
Observations	59121	59121	59121	50329	22288	22288	22288	16904
Panel B: Professor Survey Sample								
Asian Students								
w/ Asian TAs	0.012	0.012	—	—	0.039*	0.039*	—	—
	(0.009)	(0.009)	—	—	(0.022)	(0.022)	—	—
Non-Asian Students								
w/ Non-Asian TAs	-0.000	0.002	—	—	-0.007	-0.006	—	—
	(0.009)	(0.010)	—	—	(0.020)	(0.021)	—	—
Effect of Similar Race	0.012	0.014	0.014	0.025**	0.032	0.032	0.049**	0.002
	(0.011)	(0.011)	(0.011)	(0.010)	(0.020)	(0.019)	(0.023)	(0.046)
Observations	34751	34751	34751	29885	12622	12622	12622	9637
Term FE	X	X			X	X		
Course FE	X	X			X	X		
Class FE			X	X			X	X
Student FE				X				X
Controls:								
Professor		X				X		
Student		X	X			X	X	
Student X Term		X	X	X		X	X	X

Notes: Each cell reports the coefficient for similar race graduate TA composition, or in the case of "Effect of Similar Race", Asian graduate TA composition interacted with an Asian student dummy. Both outcome variables are indicators, one for whether the student passed the class and another for whether the student (Freshman or Sophomore) took another class in the same field in a subsequent term. Controls include age when class began, high school GPA, and admission year, as well as indicators for student gender, international vs. domestic, whether parents attended college, admittance (transfer vs. freshman), whether the student is majoring in the subject of the course, double major, class standing (Freshman/Sophomore/Junior/Senior), and professor gender and race. All "Effect of Similar Race" specifications include course by race and term by race fixed effects. Standard errors in parentheses, clustered by professor. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table A.3: Robustness Check – Additional Specifications

	Standardized Grade						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Full Sample							
Asian Students							
w/ Asian TAs	0.023	0.020	0.031**	—	-0.019	0.034*	—
	(0.014)	(0.017)	(0.014)	—	(0.021)	(0.017)	—
Non-Asian Students							
w/ Non-Asian TAs	0.037**	0.079***	0.045***	—	0.132***	0.040**	—
	(0.014)	(0.015)	(0.014)	—	(0.019)	(0.017)	—
Effect of Similar Race	0.061**	0.098***	0.076***	0.096***	0.113***	0.074***	0.116***
	(0.026)	(0.023)	(0.024)	(0.024)	(0.021)	(0.020)	(0.020)
Observations	57718	57718	57718	57718	49177	49177	49177
Panel B: Professor Survey Sample							
Asian Students							
w/ Asian TAs	0.034*	0.011	0.037**	—	-0.038	0.018	—
	(0.019)	(0.020)	(0.018)	—	(0.029)	(0.024)	—
Non-Asian Students							
w/ Non-Asian TAs	0.030	0.072***	0.041*	—	0.159***	0.063**	—
	(0.023)	(0.020)	(0.023)	—	(0.024)	(0.026)	—
Effect of Similar Race	0.065*	0.083***	0.077**	0.079**	0.120***	0.081***	0.118***
	(0.038)	(0.031)	(0.036)	(0.031)	(0.027)	(0.026)	(0.025)
Observations	33399	33399	33399	33399	28683	28683	28683
Panel C: Single TA Class							
Asian Students							
w/ Asian TAs	0.039**	0.036	0.043**	—	0.031	0.063**	—
	(0.017)	(0.022)	(0.019)	—	(0.026)	(0.026)	—
Non-Asian Students							
w/ Non-Asian TAs	0.051***	0.070***	0.052***	—	0.077**	0.037	—
	(0.018)	(0.021)	(0.017)	—	(0.031)	(0.022)	—
Effect of Similar Race	0.090***	0.106***	0.096***	0.108***	0.109***	0.100***	0.113***
	(0.031)	(0.034)	(0.030)	(0.035)	(0.033)	(0.030)	(0.034)
Observations	17500	17500	17500	17500	16841	16841	16841
Term FE	X		X			X	
Course FE	X		X			X	
Class FE				X			X
Student FE					X	X	X
Controls:							
Professor		X	X				
Student		X	X	X			
Student X Term		X	X	X			

Notes: Each cell reports the coefficient for similar race graduate TA composition, or in the case of "Effect of Similar Race", Asian graduate TA composition interacted with an Asian student dummy. Both outcome variables are indicators, one for whether the student passed the class and another for whether the student took another class in the same field in a subsequent term. Controls include age when class began, high school GPA, and admission year, as well as indicators for student gender, international vs. domestic, whether parents attended college, admittance (transfer vs. freshman), whether the student is majoring in the subject of the course, double major, class standing (Freshman/Sophomore/Junior/Senior), and professor gender and race. Standard errors in parentheses, clustered by professor, except for in Panel C, where standard errors are clustered by teaching assistant. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table A.4: Professor Survey Results

	Professor Survey Sample					
	All	(0)	(1)	(2)	(3)	(4)
Outcome: Standardized Grade						
Effect of Similar Race	0.080**	0.066	-0.067	0.167	0.179	0.235***
	(0.036)	(0.039)	(0.057)	(0.097)	(0.128)	(0.046)
Multiple Choice Exams	—	Yes & No	Yes	Yes	No	No
Share Exams with TAs	—	Yes & No	No	Yes	No	Yes
Class FE	X	X	X	X	X	X
Course X Race FE	X	X	X	X	X	X
Term X Race FE	X	X	X	X	X	X
Controls:						
Professor						
Student	X	X	X	X	X	X
Student X Term	X	X	X	X	X	X
Observations	33997	27837	7915	13643	897	5382

Notes: Each cell reports the coefficient on the interaction between a student identifier for Asian and fraction of TAs Asian. The first column reports estimates for the subsample of classes where professors gave a response to whether they shared the exam with the TAs and what fraction of their class' exams were multiple choice. The remaining columns consider further survey subsamples. All specifications include course by race fixed effects. Controls include age when class began, high school GPA, and admission year, as well as indicators for student gender, international vs. domestic, whether parents attended college, admittance (transfer vs. freshman), whether the student is majoring in the subject of the course, double major, and class standing (Freshman/Sophomore/Junior/Senior). Standard errors in parentheses, clustered by professor. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table A.5: Main Results by White vs. Non-White

	Dropped Class				Standardized Grade			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Full Sample								
White Students								
w/ White TAs	0.001	0.001	—	—	0.081***	0.075***	—	—
	(0.002)	(0.002)	—	—	(0.017)	(0.016)	—	—
Non-White Students								
w/ Non-White TAs	0.002	0.002	—	—	0.031***	0.029**	—	—
	(0.001)	(0.001)	—	—	(0.010)	(0.011)	—	—
Effect of Similar Race	0.002	0.002	0.003	0.002	0.111***	0.104***	0.107***	0.076***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.024)	(0.023)	(0.024)	(0.022)
Observations	60642	60642	60642	51653	57718	57718	57718	49177
Panel B: Professor Survey Sample								
White Students								
w/ White TAs	0.001	0.001	—	—	0.078***	0.071***	—	—
	(0.003)	(0.003)	—	—	(0.021)	(0.021)	—	—
Non-White Students								
w/ Non-White TAs	-0.000	-0.000	—	—	0.041***	0.038**	—	—
	(0.002)	(0.002)	—	—	(0.013)	(0.015)	—	—
Effect of Similar Race	0.001	0.001	0.002	0.001	0.119***	0.109***	0.114***	0.072**
	(0.003)	(0.003)	(0.003)	(0.005)	(0.030)	(0.030)	(0.030)	(0.030)
Observations	35649	35649	35649	30670	33997	33997	33997	29262
Term FE	X	X			X	X		
Course FE	X	X			X	X		
Class FE			X	X			X	X
Student FE				X				X
Controls:								
Professor		X				X		
Student		X	X			X	X	
Student X Term		X	X	X		X	X	X

Notes: Each cell reports the coefficient for White graduate TA composition, or in the case of Difference, White graduate TA composition interacted with a White student dummy. Standardized grade has a mean of zero and a standard deviation of one by class. Controls include age when class began, high school GPA, and admission year, as well as indicators for student gender, international vs. domestic, whether parents attended college, admittance (transfer vs. freshman), whether the student is majoring in the subject of the course, double major, class standing (Freshman/Sophomore/Junior/Senior), and professor gender and race. All "Difference" specifications include course by race and term by race fixed effects. Standard errors in parentheses, clustered by professor. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table A.6: Estimated Role of TA Race for Student Outcomes - Group by Group Regressions

Panel A: Outcome - Dropped Class

	Full sample				**Professor Survey Subsample**			
	Racial Composition of TAs *(Comparison Group: Own Race TA)*				***Racial Composition of TAs*** *(Comparison Group: Own Race TA)*			
	White	*Non-East Asian*	*East Asian*	*Hispanic (Other)*	*White*	*Non-East Asian*	*East Asian*	*Hispanic (Other)*
White	—	0.003	-0.002	0.013**	—	0.004	-0.002	0.012
	—	(0.002)	(0.002)	(0.007)	—	(0.003)	(0.003)	(0.008)
Non-East Asian	-0.006	—	-0.002	-0.005	0.007	—	0.005	-0.008
	(0.006)	—	(0.010)	(0.005)	(0.008)	—	(0.008)	(0.014)
East Asian	0.000	0.002	—	-0.004	0.000	0.005	—	0.001
	(0.002)	(0.002)	—	(0.003)	(0.002)	(0.003)	—	(0.004)
Hispanic (Other)	-0.010	0.003	-0.005	—	-0.012	-0.001*	-0.007	—
	(0.009)	(0.008)	(0.009)	—	(0.013)	(0.006)	(0.011)	—

Panel B: Outcome - Standardized Grade

	White	*Non-East Asian*	*East Asian*	*Hispanic (Other)*	*White*	*Non-East Asian*	*East Asian*	*Hispanic (Other)*
White	—	-0.023	-0.082***	-0.068	—	-0.003	-0.073***	-0.127*
	—	(0.015)	(0.016)	(0.051)	—	(0.019)	(0.024)	(0.067)
Non-East Asian	-0.078**	—	-0.085**	-0.176**	-0.096*	—	-0.110**	-0.074
	(0.038)	—	(0.037)	(0.075)	(0.053)	—	(0.045)	(0.101)
East Asian	-0.061***	-0.020	—	-0.001	-0.088***	-0.0457**	—	0.023
	(0.017)	(0.015)	—	(0.053)	(0.020)	(0.020)	—	(0.078)
Hispanic (Other)	0.022	0.032	0.056	—	0.013	-0.012	0.055	—
	(0.085)	(0.060)	(0.082)	—	(0.166)	(0.095)	(0.156)	—

Panel C: Outcome - Take Another Class in Same Field

	White	*Non-East Asian*	*East Asian*	*Hispanic (Other)*	*White*	*Non-East Asian*	*East Asian*	*Hispanic (Other)*
White	—	0.012	0.015	-0.023	—	-0.022	0.012	-0.037
	—	(0.019)	(0.016)	(0.037)	—	(0.024)	(0.035)	(0.064)
Non-East Asian	-0.063*	—	-0.016	-0.120**	-0.100**	—	0.001	-0.043
	(0.032)	—	(0.021)	(0.060)	(0.040)	—	(0.033)	(0.062)
East Asian	0.004	-0.020	—	-0.064	0.030	-0.023	—	-0.002
	(0.018)	(0.015)	—	(0.055)	(0.023)	(0.018)	—	(0.057)
Hispanic (Other)	-0.610	-0.018	-0.071	—	-0.002	0.001	-0.024	—
	(0.090)	(0.054)	(0.083)	—	(0.122)	(0.056)	(0.117)	—

Notes: This table displays results from regressions that are run separately for each student race. Each cell reports the coefficient for TA racial composition. Standardized grade has a mean of zero and a standard deviation of one. The outcome in Panel C only considers Freshmen and Sophomores, and switches on for students who took another class in the same field in a subsequent term. Controls include age when class began, high school GPA, and admission year, as well as indicators for student gender, international vs. domestic, whether parents attended college, admittance (transfer vs. freshman), whether the student is majoring in the subject of the course, double major, class standing (Freshman/Sophomore/Junior/Senior), and professor gender and race. Course and term fixed effects included. Standard errors in parentheses, clustered by professor. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Table A.7: Estimated Role of TA Race for Student Outcomes - Finer Race Groups

	Teaching Assistants Race			Teaching Assistants Race		
	East Asian	Non-East Asian	Hispanic (Other)	East Asian	Non-East Asian	Hispanic (Other)
Outcome variable	Dropped Class			Standardized Grade		
Observations	59,664			56,804		
Student Race:						
East Asian	**0.003**	0.000	-0.015**	**0.145*****	0.031	0.123
	(0.003)	(0.002)	(0.007)	**(0.030)**	(0.024)	(0.088)
Non-East Asian	0.005	**0.000**	-0.013	0.079**	**0.058**	-0.031
	(0.004)	**(0.004)**	(0.001)	(0.035)	**(0.030)**	(0.098)
Hispanic (Other)	0.009*	0.008	**0.002**	0.114***	0.035	**-0.006**
	(0.005)	(0.007)	**(0.013)**	(0.038)	(0.044)	**(0.107)**
F-test: Own-race effect (p-value)		0.854			0.000	
F-test: Race effect (p-value)		0.076			0.002	
Outcome variable	Passed Class			Take Another Class		
Observations	58,174			21,894		
East Asian	**0.025*****	0.007	0.021	**-0.015**	-0.041	-0.026
	(0.008)	(0.008)	(0.032)	**(0.023)**	(0.025)	(0.061)
Non-East Asian	0.010	**0.006**	-0.009	0.023	**-0.006**	-0.047
	(0.011)	**(0.011)**	(0.033)	(0.027)	**(0.032)**	(0.067)
Hispanic (Other)	0.027*	0.001	**0.062**	-0.021	0.016	**0.077**
	(0.016)	(0.014)	**(0.040)**	(0.031)	(0.043)	**(0.098)**
F-test: Own-race effect (p-value)		0.010			0.853	
F-test: Race effect (p-value)		0.143			0.158	

Notes: This table displays results from outcome regressions in which we allow for interactions between finer student and TA races. We only show results for our preferred specification, which includes student by term controls and class fixed effects. We report the full set of nine identified interactions for each regression. Since we include student race controls and class fixed effects, all interactions involving white students or TAs are unidentified. Same-race interactions are shown in bold. "Take Another Class" only considers the sample of Freshmen and Sophomores. p-values for an F-test of the existence of same-race interactions and for the existence of any race interactions are also listed. Standard errors in parentheses, clustered by professor. One, two, and three asterisks indicate statistical significance at the 10, 5, and 1 percent levels, respectively.