Social Science Research 66 (2017) 170–186

Contents lists available at ScienceDirect

Social Science Research

journal homepage: www.elsevier.com/locate/ssresearch

If they think I can: Teacher bias and youth of color expectations and achievement

Hua-Yu Sebastian Cherng

New York University, United States

ARTICLE INFO

Article history:
Received 2 November 2016
Received in revised form 10 April 2017
Accepted 12 April 2017
Available online 15 April 2017

For young people, academic expectations and achievement are more than measures of academic outcomes, but reflect facets of hope in their futures. A large body of literature has focused on the academic expectations and performance of racial/ethnic students of color, particularly given persistent achievement gaps. One key social actor that plays a prominent role in the formation of student expectations and academic achievement is the classroom teacher. Scholars argue that teacher support, in the form of beliefs about students' academic abilities, is crucial (Diamond et al., 2004; Weinstein, 2002). Prior work finds that students who report having teachers who believe in them academically are more successful. Researchers also argue that the boost in academic outcomes from supportive teachers is stronger for youth of color, although there are few studies that test this argument.

A related body of research on teacher support asks whether teachers' perceptions of student abilities are the same for students of color and White youth Overall, findings do not show clear evidence of teacher bias or whether bias is linked with academic outcomes. One reason for mixed findings may be that prior studies do not consider that racial stereotypes are specific to certain academic subjects (Jussim and Harber, 2005; Tenenbaum and Ruck, 2007). Moreover, few studies link evidence of bias – distinct from research on teacher perceptions – to outcomes, and in particular, outcomes that are likely shaped by teacher perceptions, such as student expectations and GPA. Therefore, given the assumption that teacher perceptions are shaped by the race/ethnicity of their students, it may be the case that less positive perceptions of certain racial groups perpetuate and exacerbate longstanding social inequalities. Addressing these biases, through better teacher preparation programs or professional development, may help eliminate these achievement differences.

To address these gaps in literature, I use nationally representative data on high school sophomores to first examine whether teachers have similar perceptions of the academic abilities of students belonging to different racial/ethnic groups after considering factors such as standardized test scores and homework completion. These analyses engage literature on specific racial/ethnic stereotypes associated with subject matter by examining math and English teacher perceptions. Second, I investigate whether teacher underestimates – beliefs that students are struggling in class when student test scores are average or higher – are associated with student expectations and GPA, and whether these relationships are more or less important for youth of color. In this study, teacher perceptions reflect teacher beliefs of student ability, which may or may not be accurate, while teacher underestimation specifically refers to teacher perceptions that are lower than what would be expected given student performance.

E-mail address: cherng@nyu.edu.

http://dx.doi.org/10.1016/j.ssresearch.2017.04.001

1. Background

1.1. Teacher beliefs and academic success

Teachers' belief in their students' academic capabilities has long been understood to be a vital ingredient for student success, and has been linked to students' own beliefs in how far they will progress, their attitudes toward schools, and achievement (Brophy, 1983; Diamond et al., 2004; Hallinan, 2008; Jussim and Harber, 2005; Sewell et al., 1969). One body of work focuses on how teacher beliefs help shape student academic beliefs. (Cheng and Starks, 2002), using data from the National Education Longitudinal Study of 1988 (NELS:88), find that 10th grade students who reported favorite teachers wanting them to go to college had 14 percent higher odds of expecting higher educational degrees by the 12th grade compared to peers who did not report the same. Rubie-Davies (2006), in a study of 256 elementary school students, finds a positive relationship between student perception of how the teacher viewed their abilities and the students' own perception of their reading and mathematics abilities: for example, students with high-expectation teachers had higher math expectations of themselves (effect size, Cohen's $d = 0.11$). Other work focuses on the link between teacher beliefs and student motivation; for example, one study of 167 predominately White middle school students finds that perceived teacher support, partially measured by teacher perceptions of students, was related to greater interest in class and school (Wentzel, 1998).[1] Finally, studies also examine the link between teacher beliefs and student achievement (Hoy et al., 2006; Südkamp et al., 2012). One experimental study of 2408 elementary school students and 90 teachers finds that students who had teachers who were taught strategies and practices to boost and sustain high expectations of their students had math test scores that were 28 percent higher than their peers who had teachers who were not provided the intervention (Rubie-Davies et al., 2015). The effect size of the treatment was $d = 0.24$. It is important to note that while teacher perceptions are linked to student outcomes, they are but one factor that shape achievement, and effect sizes are typically quite small (between 0.1 and 0.3) (Ferguson, 2003; Jussim and Eccles, 1995).

Complementing studies that examine the statistical link between teacher beliefs and student outcomes, qualitative work provides illustrations of how teacher beliefs can influence student success. Rhona Weinstein's (2002) influential publication on the power of expectations in the schooling context: “Eric was a member of the lowest reading group, which was called the ‘clowns’ [who] … stood alone and isolated, even from each other. I suggested changing the context for learning … Eric was promoted to the middle reading group and … by the end of the school year, he had reached grade level in his reading skills and he had friends. He proudly showed them off to me” (p. 3). Scholars have described the relationship between teacher perceptions and student performance as a “self-fulfilling prophecy”: “if the teacher expects high performance, [he/she] receives it, and vice versa (Rist, 1970, p. 413). The process begins with a teacher who expects a student to succeed academically, and this belief likely shapes teacher behavior, such as what assignments are given, body language the teacher uses, and the time spent with a teacher. Students respond to these high expectations by internalizing these expectations, which may boost their own expectations, as well as their academic performance.

1.2. The importance of teachers and the success of students of color

Teachers may play a more important role in influencing the academic success of students of color more than White students. Foundational theoretical work by Coleman (1988) argues that individuals belonging to socially disadvantaged groups must rely on their social capital outside of the family to succeed – “the social capital that has value for a young person's development does not reside solely within the family” (p. 113). For example, studies find that teacher perceptions can disproportionately influence the school performance of students from low social class backgrounds (Madon et al., 2001; Sorhagen, 2013; Speybroeck et al., 2012). Empirical studies suggest the same for youth of color. One study of middle school students in Michigan finds that the estimated impact of teacher perceptions for Black students was greater than for White students: spanning the lowest to highest teacher perceptions predicted a 4-unit change in grades for Black students versus a 2-unit change for White students (Jussim et al., 1996). However, the authors caution that their analyses contained only 72 Black students. In her mixed-methods study of low-income Latino and Black adolescents, Carter (2005) describes the experience of Adrienne, a student who has a teacher who recognizes Adrienne's potential and recommends her to the school's honor program. “It was my teacher and my mom - really my teacher. I missed the [qualifying] test at first, and then later my teacher drove me there, picked me up, and brought me home” (p. 148). Therefore, it may be that students of color with teachers who have confidence in their academic abilities particularly benefit from these relationships by having high academic expectations and achievement. Conversely, students of color with teachers that have low and inaccurate perceptions of their abilities may also be more negatively influenced than their White peers.

Despite literature highlighting the importance of teacher perceptions for academic success and suggesting that these perceptions may be more important for youth of color, there still remain areas of understanding that are unclear. First, much of the research relies on student reports of general teacher support; what remains missing are precise measures of teacher

[1] Teaching dimensions, which included teachers having high expectations, fairness, motivation, rule setting, and feedback, had an effect size of $d = 0.11$ to 0.49 on student motivation outcomes such as prosocial goal pursuit and interest in class.

beliefs of students from the teacher's perspective. Second, while prior research suggests that teacher perceptions of academic ability matter more for students of color, tests of this claim are lacking.

1.3. The debate over teacher bias and the importance of academic subject matter

Other research on teacher beliefs about the academic abilities of students focuses on whether teacher perceptions are the same for students of color and White students. Overall, there is mixed evidence, and one reason may be that prior work does not distinguish between teachers of different academic subject matters. One body of work argues that teachers generally rate the abilities of students of color as lower than that of white students (Alexander et al., 1987; Ainsworth-Darnell and Downey, 1998; Downey and Ainsworth-Darnell, 2002; Ready and Wright, 2011). For example, a meta-analysis of 32 studies of teacher perceptions, defined by a host of teacher reports on student talent, performance, ability, and adjustment, finds that teachers held more positive expectations for Asian American students ($d = -0.17$) and lower expectations for Latino and Black students ($d = 0.46$ and 0.25, respectively) compared to White students (Tenenbaum and Ruck, 2007).[2] It should be noted that the authors include elements such as experimental design, grade level, and location in their meta-analysis, but did not provide information on the subject matter of the teacher. Therefore, it is unclear whether these patterns exist for all teachers, regardless of subject taught, or whether expectations of different racial/ethnic groups vary by subject matter taught. In a study of 1872 elementary-aged children in 83 classrooms, McKown and Weinstein (2008) find that in classrooms where students reported unequal teacher treatment, teachers had between 0.75 and 1.00 standard deviation lower expectations of Black and Latino students than White and Asian American students. It should be noted that the authors combined Black and Latino students and White and Asian American students into two groups,[3] and did not compare the size of the gaps by subject.

The other side of the debate argues that teacher perceptions are solely based on academic performance and are not biased (Jussim, 2012; Mitman, 1985). For example, one meta-analysis of sixteen experimental studies finds that seven of the studies showed no evidence that teachers had higher expectations of White versus Black students (Baron et al., 1985). More recent work by Hinnant et al. (2009), who use survey data on 1000 elementary students in ten locations in the US, finds that teacher perceptions of children's reading and math abilities were not associated with the race of the child.[4] One study using data from ECLS-K finds that differences in kindergarten and first grade reading ability group placement between Black and White students – placements that are decided by teachers – disappear after considering socioeconomic class and prior reading and math achievement (Tach and Farkas, 2006). Similarly, Riegle-Crumb and Humphries (2012) find that math teachers have similar perceptions of the abilities of White, Black, and Latino students after considering test scores (Asian American students were not included in their study). Other studies find that teacher assessments of academic ability on external or state-wide achievement tests were similarly accurate for both Black and White students (Haller, 1985; Irvine, 1990). What is missing from research on either side of the debate over teacher bias is whether can be linked to any outcomes, such as student academic expectations or performance.

One reason that prior work, which primarily examines outcomes across academic subjects, is unable to provide a clear answer as to whether teacher perceptions are biased may be that biases differ by specific academic subjects. Theoretical and qualitative work argue that teacher biases reflect specific stereotypes about race/ethnicity and academic ability. For Black and Latino students, scholars have argued that teacher perceptions of math abilities may be particularly negative. Ladson-Billings (1997), in her discussion of math education, states that "a notion prevails in American culture that academic excellence is a result of genetic good fortune. This concept that some students "have it" whereas others do not is particularly pernicious when directed toward African American students" (p. 702) (Byrnes, 2001, 2003). argues that math teachers and Black students often do not share similar cultural backgrounds, and have "cultural incongruity." This mismatch creates tension within the classroom and hinders successful math instruction. Similarly, other scholars argue that math teachers may have negative perceptions of the abilities of Latino students (Aguirre, 2009; Bouchey and Harter, 2005). Flores (2007) states that math teachers hold "beliefs about [Latino] student capabilities and home environments … than can result in lower expectations" (p. 33). In contrast, the "Model Minority" stereotype, which paints Asian Americans as particularly successful in math compared to other minority groups (Kao, 1995; Lee, 1996), suggests that math teachers may be predisposed to highly regard the math capabilities of their Asian American students. However, stereotypes that paint Asian Americans, as well as Latinos, as perpetually foreign, regardless of nativity, can negatively impact English teachers' perceptions of their performance (Kao, 1995; Lee, 1996; Tuan, 1998).

[2] In their paper, Tenenbaum and Rick state that effect sizes of Cohen's ds between 0.20 and 0.50 indicate a small effect. Therefore, the authors note that differences in teacher perceptions are small.

[3] The authors grouped Black and Latino students and White and Asian students together into two categories: stereotyped and non-stereotyped students, and did not provide analyses by specific racial/ethnic group.

[4] In this study, the authors use a binary measure of ethnicity: White and non-White. Seventeen percent of students were non-White, and no further information on specific groups was available.

1.4. Other teacher characteristics that may shape teacher perceptions

Other teacher characteristics including race/ethnicity, experience, and beliefs of parental involvement may also be associated with teacher perceptions of academic abilities, and may explain potential teacher biases toward students from different racial/ethnic backgrounds. Research shows that the race/ethnicity and gender of the teacher may shape their perceptions of students (D. Downey and Pribesh, 2004). One study of 441 Black and White elementary school teachers in Michigan finds that Black teachers expected more of their students to transition to college than White teachers, even after considering factors such as teacher sex, education, teacher experience, and school achievement (Beady and Hansell, 1981). Previous research finds that experienced teachers are more at ease in the classroom and utilize more effective teaching techniques than their peers with less experience (Brekelmans et al., 2002; Tabacbnick and Zeichner, 1984). Therefore, it may be that more experienced teachers have more accurate perceptions of academic abilities – perceptions based on prior and current achievement – compared to their less experienced peers. Teacher perceptions of how involved parents are with their children's schooling may also influence teacher perceptions of student ability. Prior work has also shown that some educators believe that Black and Latino parents are not sufficiently involved in their children's education (Delgado-Gaitan, 1988; Valdés, 1998). It may be that teachers who believe that certain students have less educational support at home may also be less positive about their academic ability. Math teacher beliefs toward learning math may shape their teaching and perceptions of students (Aguirre and Speer, 1999; Foss and Kleinsasser, 1996). The size of the school student population and adequacy of teaching facilities shape teacher work conditions, and may also influence teacher perceptions. Finally, teacher perceptions may also differ for male and female students, as a substantial body of work has examined how math teachers perceive female students to be less capable (Beilock et al., 2010; Fennema et al., 1990; Hyde et al., 2008).

1.5. Research questions

Prior research on teacher perceptions of students has greatly informed our understanding of the importance of teachers; however, a number of gaps in knowledge remain. Scholarship that focuses on the importance of teacher perceptions on academic outcomes often relies only on student reports of general teacher support, and there is little research that teacher perceptions matter more for the academic success of youth of color. Research on potential teacher bias does not incorporate theories that argue that biases are specific to racial/ethnic groups and academic subjects. Moreover, scholarship on teacher bias overlooks older adolescent students, who likely have experienced more discrimination and are thus better able to identify discrimination. To address these gaps in prior work on teacher perceptions of students and academic success, particularly among youth of color, this paper asks two research questions: 1. How do math and English teacher perceptions of their students' academic abilities vary by student race/ethnicity? 2. How do teacher underestimations of student ability influence student academic expectations and achievement, and do these relationships vary by student race/ethnicity?

2. Data and methods

2.1. Data and sample

Data for this study came from the Education Longitudinal Study of 2002 (ELS:2002), a nationally representative study of US high school sophomores in 2002.[5] The ELS:2002 uses a sampling design that is similar to prior studies conducted by the National Center for Education Statistics, such as the National Education Longitudinal Study of 1988 (NELS:88) and the High School and Beyond longitudinal study (HS&B). The sample design employed a two-stage sample selection process. Schools were first selected with probabilities proportional to the size of the student enrollment. Next, schools were asked to provide a list of all sophomores enrolled in the school, and approximately 26 students from these rosters were selected. The student response rate for the base year was 87 percent, and 92 percent of students who participated in the base year also participated in the first follow-up. In addition to student, parent, and administrator surveys, the study also administered surveys to each student respondent's math and English teacher,[6] making the ELS:2002 an ideal dataset for this study. Moreover, patterns revealed in this study can be generalized to the US high school sophomore student population.

The ELS:2002 included 16,200 students in its base year collection.[7] I restricted the sample to students who reported a racial/ethnic group, which excluded 3900 from the sample.[8] Of the remaining 12,500 students, approximately 80 percent had

[5] (Ingels et al., 2004).

[6] The only teachers that were surveyed were math and English teachers.

[7] The numbers of observations are rounded to the nearest tens digit to adhere to NCES data rules.

[8] Given the focus on race/ethnicity, I excluded groups with small numbers of respondents, which include Native American ($n = 130$) and multiracial respondents ($n = 740$). In additional analyses not shown, all models were run with a sample where multiracial respondents were recoded to their non-White racial/ethnic category. All major results were consistent with the analyses shown in this paper. There were no differences between the analytic and non-analytic samples on outcome variables (teacher perceptions that classes are too difficult, 12th grade expectations, and 10th grade GPA) and demographic characteristics (family socioeconomic background, female, and age).

a linked teacher survey. Relatively few observations were missing data on covariates used in the analyses. I used regression-based multiple imputation to account for missing data.[9]

2.2. Variable descriptions

Appendix Table 1 shows descriptive statistics for all dependent and independent variables used in the analyses of this paper.

Teacher perception that class is too difficult for student: The first dependent variable was a binary variable that reflects whether the teacher reports that the class is too difficult for the student (coded 1 if the teacher reports the class being too difficult for the student, and 0 if the teacher reports the class being at the appropriate level or not challenging enough for the student). These measures for math and English teachers were taken from the base year teacher survey.[10] The variable captures a broad understanding of the teacher's opinion of student ability, and is based on the only question on the teacher survey that asks for the teacher's opinion of the student's performance in their class.

*Years of education expected by student in 12*th *grade:* The second dependent variable was a measure of how far in school the student expected to go. The response categories were coded in years of schooling: less than high school graduation is equivalent to 10 years of education; high school graduation or GED only (12 years); attend or complete a 2-year school course in a community or vocational school (14 years); attend college but not complete a 4-year degree (12 years); graduate from college (16 years); obtain a Master's degree or equivalent (18 years); obtain a Ph.D., M.D. or other advanced degree (20 years).

*Grade point average (GPA) in 10*th *grade:* The third dependent variable was 10th grade GPA. For the purposes of this study, it is important to note that 10th grade GPA reflected the total year end grade point average that resulted partly from instruction by English and math teachers as well as performance in other courses.[11]

The statistical analyses in this paper also included a number of covariates that reflected academic measures, teacher perceptions, teacher characteristics, and school conditions.

Student is underestimated by the teacher: These binary measures were defined as the teacher perceptions that classes were too difficult for students who scored in the top five deciles of standardized math or English tests. The measures were binary variables and coded 1 if the teacher reported that the class was too difficult for the student and the student was in the top five deciles of standardized test scores in math or English (administered as part of the ELS:2002 survey) and coded 0 otherwise. Separate measures were created for math and English teacher reports.

Race/ethnicity: Categorical measures of the four largest racial/ethnic groups were included: Asian, Latino (of any race), Black, and White (non-Latino). The reference group was White.

Family socioeconomic status: This variable was a composite indicator based on five equally weighted components: mother's education, father's education, mother's occupation, father's occupation, and family income. Parental education was measured by survey questions asking for the highest level of education reached. Parental occupation was measured by survey questions asking for the type of occupation.

Female: This variable was coded 1 if the student is female and 0 if the student is male.

Age: This variable represented the age of the student.

Standardized math score: This variable was the standardized T score on a math test administered to students in the base year of the survey. Test scores were norm-referenced to allow for comparisons with peers across the nation who took the test.

Standardized reading score: Similar to the standardized math score variable, this variable was the standardized T score on a reading test administered to students in the base year of the survey.

Student completes homework: This variable was a binary measure that captured the teacher's report of whether the student completes homework (coded 1 if the teacher reported the student completed homework most or all of the time and 0 if sometimes, rarely, or never).

Student is on academic track: This variable was a binary measure that reflected the student report of whether their course-taking was college preparatory (coded 1) or vocational/general (coded 0).

Math teacher believes you have to be born with good math ability: This variable was a binary measure that reflected the teacher's report of whether an individual had “to be born with the ability to be good at math” (coded 1 if the teacher strongly agreed or agreed with the statement and 0 if the teacher disagreed or strongly disagreed). This variable was taken from a survey question asked only of math teachers.

[9] Dealing with missing data using multiple imputation methods addresses the fact that standard errors that are typically too small when using single imputation techniques. For these analyses, I created 20 imputed datasets. I impute all independent variables except for student and teacher race/ethnicity, student gender, and student age.

[10] On average, teachers completed surveys in late March to early April 2002. A question on the teacher survey also asked whether teachers had taught the student in fall 2001: 90 and 89 percent of math and English teachers, respectively, reported working with students the semester prior to the survey administration. Therefore, the large majority of teachers had interacted with students for 1.5 semesters or more, which should be sufficient time for teachers to become familiar with the academic abilities of their students.

[11] 87 percent reported teaching the student in both the fall of 2001 and the spring of 2002. The ELS:2002 also administered a student math exam, but not a reading exam, in the first follow-up wave. In analyses that estimate standardized math test scores from 12th grade as a function of teacher underestimations, the main results were similar to analyses examining 12th grade expectations.

Teacher perceives that parents are involved: This variable was a binary measure that reflected the teacher's perception of how involved the student's parents are in the child's academic performance (coded 1 if teacher perceived parents to be very or somewhat involved and 0 if teacher perceived parents to be not involved).

Teacher impact on learning scale: This variable was a continuous measure that reflected how important teachers perceived their role to be in the academic success of the student. The measure was a factor variable that included the following questions: how important was the teacher's attention to the unique interests and abilities of the student; how important was the teacher's use of effective methods of teaching; and how important was the teacher's enthusiasm or perseverance to the success of the student. The scale was constructed using standardized values (the mean is 0 and variance 1) of the individual measures of participation. Higher values on this scale reflected a greater perceived role of the teacher in student success.[12]

Teacher is female: This variable was coded 1 if the teacher is female and 0 if the teacher is male.

Teacher race/ethnicity: This variable included categories for whether the teacher was White, Black, Asian, or Latino (of any race).

Teacher's years of experience: This variable represented the total number of years the teacher had taught in any school.

Grade point average (GPA) in 9th grade: This measure represented the 9th grade GPA of the student.

School size in highest quintile: This binary variable captured whether the teacher may be overburdened in the classroom by teaching many students, and was coded 1 if the school was in the highest quintile of school population and 0 if the school was in the bottom four quintiles of school population.

Adequate instructional space: This binary variable was based on a question from the administrator questionnaire and was coded 1 if learning in the school was not hindered by lack of instructional space and 0 if learning was hindered.

2.3. Analytic strategy

The analyses began by examining averages of math and English reports that the class was too difficult for the student, student expectations reported in 12th grade, and 10th grade GPA, by the race/ethnicity of the student. I used two-sample t-tests to determine whether there were descriptive differences in teacher perceptions. I then used logistic regression to examine whether racial/ethnic differences in math and English teacher perceptions of students' academic ability were linked to measures of academic performance and other factors such as other student characteristics, teacher characteristics, and school conditions. Given that one of the goals of the study is to examine the "effects" of teacher underestimation – perceptions that the class was too difficult for students who score average or higher on standardized tests – on academic outcomes (12th grade expectations and 10th grade GPA), a set of propensity score matching analyses can help estimate these effects without a randomized control trial. There are a number of shortcomings to relying on traditional methods of regression analyses to examine the "effects" of teacher underestimation. First, regression models assume that the relationships between x, a covariate, and y, the outcome, are linear and additive. If there are misspecifications in the control variables (i.e., there are nonlinearities in the regression function), then the estimation of the treatment effects will be biased. Model misspecification can also lead to problems with endogeneity such that a predictor variable is related to both the outcome and the error term. Second, regression analyses tend to extrapolate effect estimates based on students who have very high propensities of never or always being underestimated, and not students who overlap in their propensities of being underestimated. In other words, regression analyses may calculate an "effect" based on a configuration of students that are not found in the sample (and given that the sample is nationally representative, one that is found in the population as well).

Propensity score matching can help address these shortcomings of regression analyses (Rosenbaum and Rubin, 1983). Propensity score matching, as a type of matching analyses, provides a convenient matching index that is the propensity of being treated. The procedure reduces the complexity of the multivariate matching process to a single variable: a propensity score. First, propensity score matching calculates treatment effects only on students who actually overlap in their propensities of being underestimated by teachers, with some actually being underestimated and others not. Therefore, treatment effects are not extrapolated from individuals who may share very few characteristics. Second, matching techniques allow us to estimate the treatment effect based on comparing the mean outcomes between the matched treatment and control samples, without running a regression model with stringent model specification. In this sense, we can avoid bias due to model misspecification.

In this study, I use propensity score matching to control covariate-balanced matched samples that mimics a random control trial. The treatment effect can then be conveniently estimated by comparing outcomes of students between the matched samples, where the "treatment group" included students who were academically underestimated by math or English teachers and the "control" group consisted of students who were not underestimated. Specifically, I will aim to estimate the treatment effect among the treated group (ATT). To do so, for each student in the treatment, I find a student in the control sample whose propensity score is the closest as the match. For this study, the propensity score is the propensity of being underestimated by teachers and others not. The matching equations are logistic regressions estimating whether the math or English teacher underestimated the student, and the matching equations had the same covariates found in Tables 2 and 3, respectively. The academic outcomes – academic expectations and GPA – were then compared between students with similar propensities who were and were not underestimated by their teachers. The Stata program PSMATCH2 was used to

[12] The Cronbach's alpha values for the teacher impact on learning variables are 0.78 for math teachers and 0.77 for English teachers.

Table 1
Descriptive statistics on dependent variables by race/ethnicity.

	Math teacher perceives that class is too difficult for student		English teacher perceives that class is too difficult for student		Years of education expected by student, in 12th grade			10th grade GPA		
	Proportion		Proportion		Mean	SD				
White	0.08		0.06		16.43	2.15		2.83	0.81	
Asian	0.10	*	0.10	***	17.11	2.18	***	2.95	0.87	***
Latino	0.14	***	0.12	***	15.95	2.30	***	2.33	0.89	***
Black	0.18	***	0.13	***	16.45	2.29		2.22	0.81	***

Note: Two sample t-tests were used.
***p < 0.001, **p < 0.01, *p < 0.05.

execute the propensity score matching analyses (Leuven and Sianesi, 2003). Mahalanobis distance matching from a randomly ordered dataset was used. After matching, there were no statistically significant differences between the means of covariates between the treatment and control groups. There is also significant overlap in propensity scores, or region of common support, between the treatment and control groups.

I also examined whether associations between teacher underestimations and subsequent academic outcomes vary by students belonging to different racial/ethnic groups, and used linear regression estimating 12th grade expectations and 10th grade GPA and included interaction terms between student race/ethnicity and whether the teacher underestimated the student. All analyses used appropriate weights to adjust for oversampling of Asian American and Latino students and incorporated primary sampling units to adjust standard errors.

3. Results

The first research question asks how math and English teacher perceptions of their students' academic abilities vary by student race/ethnicity. Table 1, which shows descriptive statistics on the four outcome measures in these analyses, begins to address this question. Overall, a higher percentage of both math and English teachers report that their class is too difficult for Asian American, Latino, and Black students compared to White students. The greatest gap is for Black students: more than twice the percentage of math and English teachers report that their class is too difficult for Black students – 18 and 13 percent, respectively – compared to White students (8 and 6 percent). Gaps between Latino and Whites students are also sizeable: with both math and English teachers, there is a 6 percent difference in their reported assessment of Latino and White students' abilities. Finally, there is a smaller but still significant gap of 2 percentage points between White and Asian American students on math teacher perceptions, but a larger 4 percentage point gap on English teacher reports. Table 1 also reveals some racial/ethnic differences in 12th grade expectations and 10th grade GPA. Asian American students, on average, expect 0.68 more years of education and Latino students 0.48 years less of education, compared to White students. The expectations between White and Black students are statistically the same, at approximately 16.44 years. In terms of GPA, Asian American students on average have higher GPAs than White students, and Black and Latino students have lower GPAs than White students. All differences are statistically significant at the $p < 0.05$ level.

From Table 1, we see that a greater proportion of math and English teachers report that their class is too difficult for youth of color. Racial/ethnic gaps also differ by subject matter, but not in a clear way. However, teacher reports are likely related to academic performance and teacher perceptions, among other factors. Table 2 takes these factors into consideration and presents odds ratios from logistic regression models that estimate math teacher perceptions that their class is too difficult for the student. Overall, the table provides evidence that math teachers have less positive perceptions of the academic abilities of Latino and Black students compared to White students, even after considering a host of covariates.

The organization of Table 2 is as follows. Model 1 includes only variables for student socio-demographic characteristics, which include student's race, family socioeconomic status, whether the student is female, and age. Models 2, 3, 4, and 5 add separately student academic measures (standardized math test score, whether the student completes homework, whether the student is on an academic track), teacher perceptions (whether the teacher believes you have to be born with good math ability, teacher perceptions that parents are involved, teacher beliefs of teacher impact on learning), teacher characteristics (teacher's gender, race/ethnicity, years of teaching experience), and school condition measures (whether the school population size is in the highest quintile and whether there is adequate instructional space), respectively. Model 6, the full model, includes all variables from the previous models.

Turning first to Model 1, we find that net of socioeconomic status, sex, and age, math teachers are more likely to report that their class is too difficult for Latino students (50 percent higher odds) and Black students (more than 100 percent higher odds) compared to White students. A gap remains throughout most of the models, and notably in the final model, Model 6. In none

Table 2
Odds Ratios from Logistic Regression Models Estimating Math Teacher Perception that Class is too Difficult for Student.

	(1)	(2)	(3)	(4)	(5)	(6)
Student characteristics						
Race/ethnicity (reference: White)						
Asian	1.29	1.43	1.29	1.21	1.41	1.48
Latino	1.50*	1.12	1.48*	1.45*	1.69*	1.27*
Black	2.07**	1.30*	2.08**	2.01**	2.15**	1.38*
Family socioeconomic status	0.74*	1.01	0.77*	0.74*	0.75*	0.99
Female	1.08	1.32	1.09	1.08	1.10	1.33
Age	1.25**	1.06	1.23**	1.25**	1.26**	1.06
Academic measures						
Standardized math score		0.95**				0.95**
Student completes homework		0.22**				0.22**
Student is on academic track		1.03				1.02
Teacher perceptions						
You have to be born with good math ability			1.32*			1.25***
Parents are involved			0.70*			0.90
Impact on learning scale			0.90*			1.13*
Teacher characteristics						
Female				0.95		1.02
Asian (reference: White)				1.76*		1.70*
Black				1.07		0.93
Latino				1.08		1.19
Years of experience				1.26		1.30
School conditions						
School size in highest quintile					1.48*	1.51*
Adequate instructional space					1.08	1.04
Observations	10,160	10,160	10,160	10,160	10,160	10,160

***p < 0.001, **p < 0.01, *p < 0.05.

of the models is there evidence that math teachers perceive the academic ability of Asian American students differently from White students.[13]

In addition to math teacher perceptions differing by the racial/ethnic group of the student, perceptions also are associated with other factors. Math teachers are less likely to perceive that math class is too difficult for students with higher test scores and students who complete homework (Model 2).[14] The perception that an individual has to be born with good math ability is associated with higher odds of teachers perceiving the class as being too difficult for the student, while the opposite is true for beliefs that parents are involved and that teachers have a stronger impact on learning (Model 3). The only teacher demographic measure that is statistically significant suggests that Asian American math teachers, compared to White math teachers, have higher odds of reporting a class being too difficult for a student (Model 4), although it should be noted that Asian Americans make up less than 2 percent of math teachers in the sample. Teachers who work in the largest of schools also have higher odds of reporting that the class is too difficult for the student (Model 5). Finally, across all models except Model 6, math teachers have higher odds of reporting that the class is too difficult for older students, and in some models, the student's socioeconomic status is negatively associated with the outcome. This finding suggests that even net of other factors such as race/ethnicity, teachers also have lower expectations of students who occupy lower socioeconomic spaces, which may also constitute a class bias in teacher perceptions. However, it should be noted that in the full model (Model 6), the variable representing socioeconomic status is not statistically significant.

Results from Table 2 suggest that math teachers perceive Latino and Black students to be less academically capable compared to White students. Table 3 examines patterns of English teacher perceptions, and shows odds ratios from logistic regression models predicting whether English teachers perceive that their class is too difficult for the student. Overall, Table 3 suggests that English teachers have higher odds of perceiving that their class is too difficult for students of color compared to White students.

The organization of Table 3 is similar to the previous table.[15] In Model 1, Latino and Black students have 66 and 87 percent higher odds, respectively, of having English teachers report that the class is too difficult for them. Patterns for Latino and Black students are robust across all models. Moreover, in the final model, Model 6, English teachers are also more likely to report that their class is too difficult for Asian American students: Asian Americans have 53 percent higher odds of English teachers

[13] It is well documented that students and teachers are not randomly sorted across schools (Clotfelter et al., 2005; Goldhaber et al., 2015). In a set of tertiary models, not shown, school fixed effects models are run that estimate teacher underestimations (by math and English teachers). Overall, results from the school fixed effects models mirror those of the findings in Tables 2 and 3.

[14] For example, students who complete their homework most or all of the time have 78 percent lower odds of having a math teacher perceive that the class is too difficult compared to students who completely their homework less frequently.

[15] Table 3 does not include the question about whether an individual had to be born good at math.

Table 3
Odds Ratios from Logistic Regression Models Estimating English Teacher Perception that Class is too Difficult for Student.

	(1)	(2)	(3)	(4)	(5)	(6)
Student characteristics						
Race/ethnicity (reference: White)						
Asian	1.26	1.47	1.21	1.29	1.24	1.53*
Latino	1.66**	1.35*	1.62**	1.70**	1.62**	1.39*
Black	1.87**	1.42**	1.78**	2.12***	1.86**	1.62*
Family socioeconomic status	0.81	1.03	0.87	0.80*	0.80	1.04
Female	0.86	1.10	0.87	0.86	0.86	1.10
Age	1.21	1.03	1.16	1.21	1.21	1.02
Academic measures						
Standardized reading score		0.97*				0.97
Student completes homework		0.75**				0.74**
Student is on academic track		1.00				1.01
Teacher perceptions						
Parents are involved			0.58*			1.09
Impact on learning scale			0.98			0.99
Teacher characteristics						
Female				1.22**		1.26
Asian (reference: White)				1.10		0.79
Black				0.44		0.41
Latino				0.97		0.86
Years of experience				1.00		1.00
School conditions						
School size in highest quintile					1.06	1.06
Adequate instructional space					1.04	0.97
Observations	9710	9710	9710	9710	9710	9710

***p < 0.001, **p < 0.01, *p < 0.05.

reporting that the class is too difficult for them compared to their White peers. Most major covariates included in the models operate in a similar fashion as in Table 2.

The previous tables provide evidence that addresses the first research question. Teacher perceptions do vary by race/ethnicity and subject matter. Specifically, it appears that math teachers perceive their classes to be too difficult for Latino and Black students, and English teachers perceive their classes to be too difficult for all non-White students. Next, I turn to the second research question: how do teacher underestimates - defined here as perceptions that the class is too difficult for the students who score in the top five deciles of standardized math or English tests - influence student academic expectations and achievement, and do these relationships vary by student race/ethnicity?

To examine whether the influence of teacher underestimations on expectations and GPA vary by student race/ethnicity, we turn to the final three tables. Table 4 shows the results of a propensity score matching analysis and treatment effects of being underestimated by teachers on 12th grade expectations and 10th grade GPA. Results are shown separately for underestimations by math and English teachers. Overall, being academically underestimated by teachers appears to have deleterious effects on later expectations and subsequent academic achievement. For example, being underestimated by English teachers – in these analyses, the treatment – lowers student expected years of schooling by almost a third of a year less of schooling. Similarly, after matching, the effect of being underestimated by math teachers is −0.20 GPA points.

To investigate whether the relationship between teach underestimation and academic outcomes vary for different student groups, we turn to the next two tables. Table 5 shows standardized coefficients from linear regression models that estimate the years of expected education the student reports as a high school senior. Separate models are estimated to examine the association between 12th grade expectations and math (Models 1 and 2) and English (Models 3 and 4) teacher

Table 4
Treatment effects of being underestimated by teachers on 12th grade expectations and 10th grade GPA.

Variable	Sample	Treated	Controls	Difference	T-stat
12^{th} grade expectations					
Math	Unmatched	16.42	16.74	−0.32	−3.39
	ATT	16.42	16.62	−0.20	−1.43
English	Unmatched	16.44	16.74	−0.30	−2.72
	ATT	16.44	16.76	−0.31	−2.02
10^{th} grade GPA					
Math	Unmatched	2.32	2.79	−0.47	−13.91
	ATT	2.32	2.52	−0.20	−4.83
English	Unmatched	2.32	2.79	−0.47	−12.03
	ATT	2.32	2.49	−0.18	−3.44

Note: Differences between treated and control groups, both before and after matching, are statistically significant at the p < 0.05 level.
Note: Average Treatment Effect on Treated (ATT), for the given analyses, is the effect of being underestimated by teachers on 12th grade expectations and 10th grade GPA.

Table 5
Standardized coefficients from linear regression models estimating years of expected education in 12th grade.

	Math teacher		English teacher	
	(1)	(2)	(3)	(4)
Student is underestimated by teacher	−0.03*	−0.02	−0.02	−0.01
Student characteristics				
Race/ethnicity (reference: White)				
Asian	0.05**	0.05**	0.05**	0.05**
Asian X underestimated		−0.02		−0.01
Latino	0.03	0.03	0.03	0.03
Latino X underestimated		−0.02**		−0.01*
Black	0.06*	0.07*	0.06*	0.06*
Black X underestimated		−0.02+		−0.02*
Family Socioeconomic Status	0.19***	0.19***	0.19***	0.19***
Female	0.06**	0.06**	0.06***	0.06***
Age	−0.04	−0.04	−0.04	−0.04
10th grade GPA	0.06*	0.06*	0.06*	0.06*
Expectations in 10th grade	0.45**	0.45**	0.45**	0.45**
Observations	9520	9520	9520	9520

***p < 0.001, **p < 0.01, *p < 0.05.

underestimations. Model 1 includes a measure for whether the math teacher underestimates the student, as well as measures of student's race/ethnicity, family socioeconomic status, gender, age, 10th grade GPA, and academic expectations in 10th grade. Model 2 introduces interaction terms between student's race/ethnicity and math teacher underestimations. Models 3 and 4 follow the same logic as Models 1 and 2, but include measures of English teacher underestimates of students.

Turning first to Model 1 we find evidence that math teacher's early underestimation of student ability is associated with lower student expectations in their senior year: students who are underestimated by math teachers in 10th grade have 0.03 of a standard deviation lower years of expectation in 12th grade, which translates to approximately one third of a year lower. In Model 2, the statistically significant and negative interaction terms between math teacher underestimations of Latino students show that the negative association between math teacher's underestimation expectations is larger for Latino students than for White students.

Models 3 and 4 estimate student expectations as a function of English teacher underestimation. From Model 4, we see that the interaction terms between a student being underestimated by an English teacher and being a Latino or Black student are statistically significant and negative, which suggests that Latino and Black students are particularly disadvantaged by English teacher's underestimations of their ability. To aid in the interpretation of these results, predicted number of years of expected education are presented in Appendix Figs. 1 and 2.

Turning to the last outcome, Table 6 shows coefficients from linear regression models that estimate the 10th grade GPA, which resulted partly from instruction students received in that year by English and math teachers. The organization of Table 6 is the same as the previous table. Model 1 focuses on math teacher underestimations of students and also includes measures of students' race/ethnicity, family socioeconomic status, gender, age, and prior achievement (9th grade GPA). Models 2 introduces interaction terms between students' race/ethnicity and underestimation. Models 3 and 4 examine English teacher underestimations of students, and are organized in a similar fashion to the previous two models.

From the first two models, we find evidence that math teacher underestimations of students are associated with lower GPAs: for example, in Model 1, on average, students who are underestimated by math teachers have 0.14 of a standard

Table 6
Standardized coefficients from linear regression models estimating 10th grade GPA.

	Math		English	
	(1)	(2)	(3)	(4)
Student is underestimated by teacher	−0.14**	−0.14**	−0.12**	−0.12**
Student characteristics				
Race/ethnicity (reference: White)				
Asian	0.04**	0.04***	0.04*	0.04*
Asian X underestimated		0.01		0.01
Latino	−0.11*	−0.11*	−0.11**	−0.10**
Latino X underestimated		0.01		0.01
Black	−0.16*	−0.16*	−0.16*	−0.16*
Black X underestimated		0.01*		0.02*
Family Socioeconomic Status	0.25**	0.24**	0.25**	0.25**
Female	0.14***	0.14***	0.14**	0.14**
Age	−0.10**	−0.10**	−0.10*	−0.10*
9th grade GPA	0.27*	0.27*	0.27*	0.27*
Observations	9490	9490	9490	9490

***p < 0.001, **p < 0.01, *p < 0.05.

deviation lower GPA, which translates to 0.34 lower GPA points, than their peers who are not underestimated even after considering prior achievement and all other variables in the model. From Model 2, we find that the negative association between being underestimated and GPA is smaller for Black students; that is, the difference between Black students' GPAs who are underestimated and those who are not is smaller than the difference between their White counterparts. A similar pattern is observed for English teacher underestimations (Models 3 and 4). Predicted GPAs are presented in Appendix Figs. 3 and 4.

4. Discussion

4.1. Summary

This study asked two research questions about the link between teacher perceptions and underestimations and the expectations and achievement of students of color. The first research question sought to test whether math and English teachers – whose pedagogical training and leanings may differ – varied in their perceptions of students, thus lending both theoretical and empirical evidence to the debate over the existence of teacher bias. Results show that on average, teachers are more likely to perceive that their class is too difficult for students of color compared to White students. Regression analyses revealed that math teachers consistently perceive their class to be too difficult for Latino and Black students even after controlling for math test scores, homework completion, and a host of other factors. English teachers underestimate the academic abilities of Black and Latino students, and in some models, Asian American students as well.

The second question asked how teacher underestimates influence student academic expectations and achievement, and whether these relationships vary by student race/ethnicity. Both math and English teacher's underestimation of student academic ability in the 10th grade is associated with lower 12th grade expectations and 10th grade GPAs. Moreover, these relationships also vary by student race/ethnicity. In terms of later academic expectations, Latino students fare worse than their White counterparts in terms of their academic expectations when they are underestimated by math teachers, and Latino and Black students fare worse when they are underestimated by English teachers. However, the negative relationship between teacher underestimation and GPA is smaller for Black students, which shows the association between teacher underestimation and GPA is weaker for Black students compared to White students.

4.2. Implications

Among education researchers, policymakers, and practitioners, there is strong agreement that teacher perceptions matter for student expectations and achievement, and perhaps more so for youth of color. While some scholars have argued that teacher perceptions are biased against youth of color, the evidence is mixed (Ainsworth-Darnell and Downey, 1998; Downey and Ainsworth-Darnell, 2002). This paper draws from both theoretical and empirical perspectives and asked whether teacher perceptions are biased, whether these potential biases are linked to academic outcomes, and whether teacher bias matters differently for students of color versus White students. I find that teacher perceptions may be biased and conform to subject-specific racial stereotypes found in literature. These biases are linked to lower student expectations and achievement, but the relationships are not the same for all student groups.

Turning to the first research question – whether there exists teacher bias – I find evidence of teacher underestimations when analyzing patterns by different subject matters. In terms of subject-matter differences in perceptions, prior work argues that racial stereotypes are often specific to subject matter (Ladson-Billings, 1997). Results from this study show that Latino and Black students are more likely to be underestimated by math teachers compared to their White peers, which is consistent with work that finds that math teachers may have low perceptions of certain groups, like Latino and Black youth, but not others, like Asian American youth (Ainsworth-Darnell and Downey, 1998; Tenenbaum and Ruck, 2007). This difference among students of color may be explained by the Model Minority Stereotype, which describes Asian Americans as being more talented in math than other minority groups. However, under the stereotype, Asian Americans are only models for other minority groups, as the name of the stereotype implies, and not Whites. Therefore, it may not be a surprise that Asian Americans are similar to White students in terms of their outcomes in these analyses.

In contrast to patterns in math teacher underestimations, all groups of non-White students are more likely to be underestimated by English teachers. The fact that Black students are more likely to be underestimated by both math and English teachers suggests that Black students may be viewed as less academically capable by teachers across subjects. Latino and Asian American students may be perceived to be "forever foreign" (Calafell, 2004; Lee, 1996; Wilson II and Gutiérrez, 1995); therefore, English teachers may perceive that students belonging to these groups struggle with English.

Addressing the second research question, teacher underestimations matter, and they matter differently for different groups of students. This paper examined the association between teacher perceptions and two outcomes: student expectations and GPA. Findings from this paper are consistent with the argument of the "self-fulfilling prophecy": although the concept was defined initially around the benefits of high teacher expectations, the same mechanism can be used to help explain the main findings of this paper: that teachers' underestimations of student ability are deleterious to students' self-conception and lead to poorer academic outcomes (Farkas, 1996; Jussim, 2012; Rist, 1970). Guyll et al., 2010 describe steps that underlie the negative consequences of the self-fulfilling prophecy. "First, a perceiver must hold a false belief about a target, as when a teacher underestimates a student's true potential. Second, the perceiver must treat the target in a manner

that is consistent with the false belief, such as if a teacher presents easier material to low-expectancy students … the target must confirm the originally false belief, as when a low-expectancy student under performs."

However, results also suggest there is important nuance to this overall argument. Drawing from theories that highlight the role of teachers in fostering student academic confidence – particularly for youth that have fewer resources outside of school – this paper finds not only a link between teacher underestimation of academic ability and lower student expectations, but that this relationship is stronger for students of color. Stereotype threat (Steele and Aronson, 1995) describes the notion that Black student performance is lower when students are primed to think of racial stereotypes. Results from this study are consistent with racial stereotypes formed around subject matter, and while only two subjects – math and English – were examined in this study, it may likely be the case that biases also form on subjects that are related to math skills, such as science and technology courses, and English skills, such as social science and humanities subjects. It may be that adolescents of color underestimated by their teachers perceive such underestimation to be rooted in racial stereotypes. This may help explain the finding that expectations of students of color are particularly disadvantaged by teacher underestimations. Therefore, youth who are in the most need of academic guidance may not be receiving the encouragement they need to flourish. This may be particularly salient to high school students as they are deciding whether to pursue higher education. And in broader conversations of educational equity and teachers as a valuable source of social capital, the finding that teacher perceptions are more important for youth of color compared to White youth also attest to youth of color's lack of social capital within the school context. Although many youth of color have families with high levels of socioeconomic resources at home, they may still lack the social connections that can help them navigate schools, which remain a social institution that reflects mainstream, White norms.

In contrast to the stronger role teacher underestimations plays in shaping Latino and Black student expectations, for Black students, the relationship between teacher underestimations and GPA, though still negative, is weaker. This may be explained by work that focuses on academic strategies Black students use to combat racial discrimination in education. Resistance to teacher underestimations may be unique to Black students, who have a long history of resisting discrimination within schools. This historical context may be less applicable to Asian American and Latino students, who are largely the children of immigrants. Scholars have argued that Black students in particular are aware of teacher bias, such as underestimating their academic abilities, and resist such characterizations (Andrews, 2012; Brown, 2007; Ebata and Moos, 1994; Munn and Lloyd, 2005; Skiba and Knesting, 2001) (Polite, 1993). writes, "[Black adolescents] fully understand that as blacks they will encounter obstacles, prejudices, and inequities, but they never view their race as the cause of the problem. It is this essential recognition that grounds [their] thinking, enabling them to … gain a powerful measure of … strength from the … struggles that racism inevitably demands" (p. 6). Carter (2005) finds that many high school students had "stories of problematic relationships with teachers who seemed to have low expectations of them and their classmates" (p. 66), but would still push themselves academically. Rayisha, a Black female junior in Carter's study, was able to quickly identify and resist teachers' bias against her, and even encouraged a classmate to "stand up for herself and challenge a teacher about a grade" (p. 68). Sanders (1997) finds in her interview study of Black eighth-graders that a prominent response to teacher discrimination is a commitment to academic success: "I know that being Black … I am going to work hard to prove what I can do …. I am willing to work hard … If sometimes tells me that I can't, I just find a way to do it. It makes me want to do it more (Denise, a Black female eighth grader, p. 89). Similarly, Kenneth, a Black male eight grader says that "racism makes me strive harder … they [Black men] are there, making it, regardless of what people say, and I see getting there as a challenge." (p. 89). Therefore, it may be that Black students who perceive that they are underestimated by teachers also work harder to challenge teachers' assumptions of their abilities, which can help offset the negative influence of underestimations on immediate achievement. However, the ameliorating influence of Black academic resistance to discrimination may not exist to long-term or more abstract outcomes, such as academic expectations. The process through which a student forms their expectations to go to college is a complex process, with teacher influence being one of many important ingredients.

Some limitations to this study are worth noting. First, the measure of teachers perceiving the class to be too difficult for the student is broad, and does not contain more nuanced information on what aspects of the course are challenging for the student. For example, we are unable to determine whether the teacher perceives that the class is too difficult for the student due to workload, poor performance on examinations, or lack of enthusiasm toward the subject. Each aspect is likely shaped by racial stereotypes. Prior work has found that English teachers are more likely to perceive that Asian American youth are withdrawn and passive in class (Cherng, 2017), which teachers may interpret as lack of enthusiasm. As a result, teachers may then perceive that their class is too difficult for Asian American students – not due to their inability to handle the workload, per se – but because of their lack of engagement. However, the measure still captures an important opinion of teachers, and a perception that is linked with student outcomes. Second, racial/ethnic categories used in the analyses may not reflect variations across smaller ethnic groups.[16] Third, while findings are significant and can be generalized to a broad US context, the magnitude of differences are often small, which is consistent with effect sizes from other studies (Ferguson, 2003; Jussim and Eccles, 1995). This is perhaps not surprising given that teacher perceptions are just one of many factors that shape student

[16] In a separate analyses, racial/ethnic groups were furthered categorized by parental and student nativity into first-, second-, and third-generations. In almost all cases, findings were consistent with racial/ethnic patterns in this paper; that is, coefficients for all generations within each racial/ethnic group were statistically significant at the $p < 0.05$ level. Therefore, it is likely the case that teachers academic perception of students are linked to the race/ethnicity, but not the generation-status, of the student.

expectations and GPA. Despite its strengths, there are also important limitations to propensity score matching analysis. Propensity score matching cannot eliminate bias due to differences that are unobserved across treatment and control groups (Heckman et al., 1998). This limitation can manifest in the matching equation, as the matching equation is only able to utilize observable characteristics and any unobserved variables can comprise the matching process. This bias due to unobservable variables can also increase the bias of the average treatment on treated (ATT) estimates. In the context of this paper, both theoretical and empirical bodies of literature were used to determine what student, teacher, and school characteristics would likely predict teacher perceptions of academic ability. The premise of the paper is that in addition to academic achievement, student race and ethnicity also shape teacher perceptions. These variables form the crux of the matching equations and whether students are underestimated by their teachers.

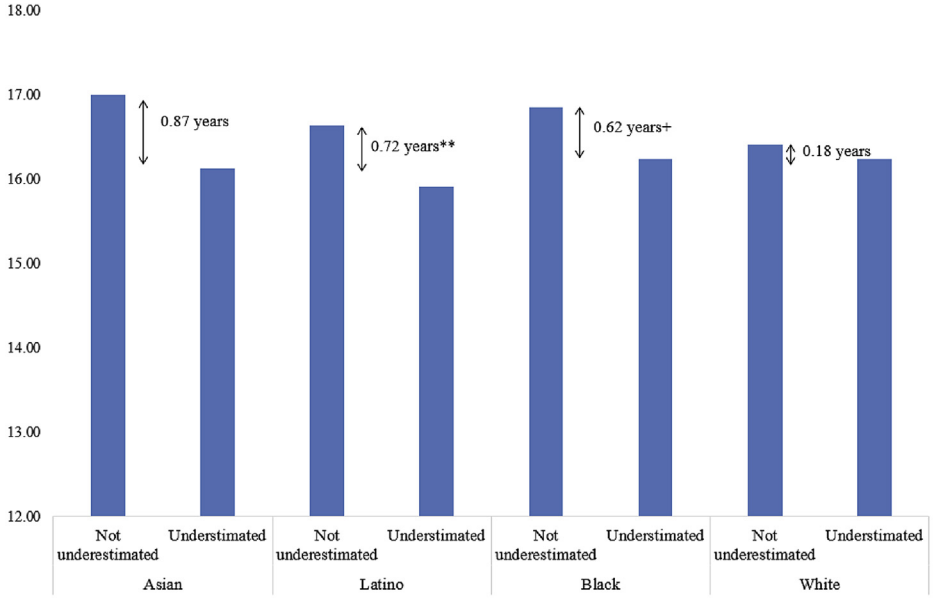
On the whole, results from this study highlight the need for dialogue about racial/ethnic biases that are likely widespread in education. These conversations may not be easy. Farkas (2003) states that "researchers, policy makers, and school administrators have shown little support for the notion that monitoring such attitudes or behaviors [of teacher bias] is likely to be either practical or useful. Indeed, many seem to believe that such efforts would provoke a counterproductive backlash among teachers" (p. 1141). However, the findings of this study, along with those of other studies, underscore the importance of teacher training and professional development that can directly address issues of biases in teacher perception and help teachers bolster the success of all students.

Appendix

Table 1
Descriptive statistics for variables used in analyses.

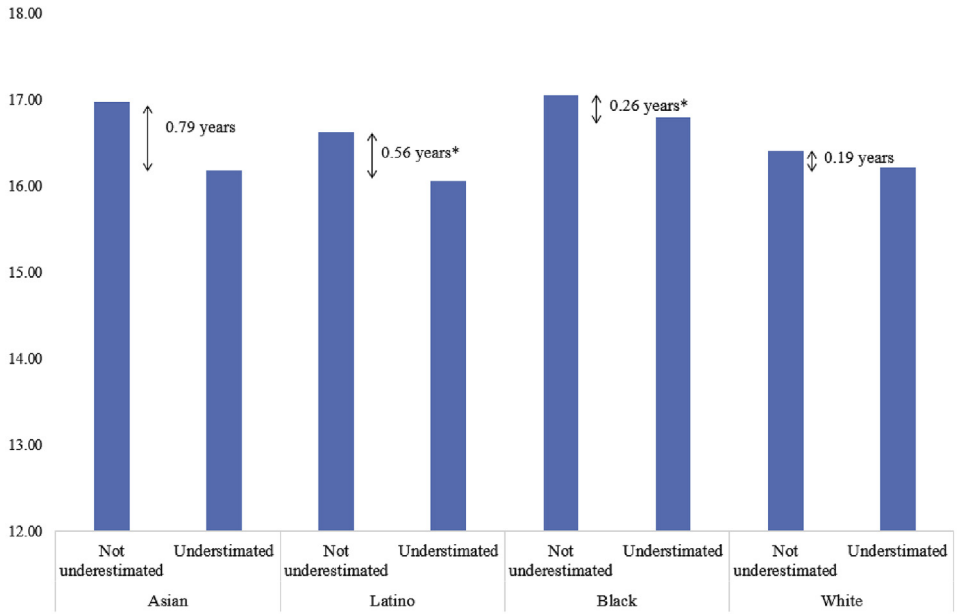
	Mean/Proportion	Standard deviation/N	Range
Outcome Variables			
Math teacher perceives that class is too difficult for student	0.11	10,160	0.00 to 1.00
English teacher perceives that class is too difficult for student	0.09	9710	0.00 to 1.00
10^{th} grade GPA	2.67	0.86	0.00 to 4.00
Years of education expected by student, in 12th grade	16.38	2.21	11.00 to 20.00
Student characteristics			
White	0.62	6020	0.00 to 1.00
Asian	0.10	970	0.00 to 1.00
Latino	0.13	1260	0.00 to 1.00
Black	0.15	1460	0.00 to 1.00
Family Socioeconomic Status	0.03	0.73	−2.11 to 1.82
Female	0.50		0.00 to 1.00
Age	16.46	0.60	15.00 to 19.00
10^{th} grade GPA	2.70	0.83	0.00 to 4.00
9^{th} grade GPA	2.78	0.81	0.00 to 4.00
Math teacher perceptions			
Student completes homework	0.67	6510	0.00 to 1.00
You have to be born with good math ability	0.31	3010	0.00 to 1.00
Parents are involved	0.24	2330	0.00 to 1.00
Impact on learning scale	−0.01	0.76	−1.18 to 3.27
Student is underestimated by teacher	0.06	580	0.00 to 1.00
English teacher perceptions			
Student completes homework	0.69	6700	0.00 to 1.00
Parents are involved	0.24	2330	0.00 to 1.00
Impact on learning scale	−0.01	0.75	−1.51 to 4.09
Student is underestimated by teacher	0.05	500	0.00 to 1.00
Math teacher characteristics			
Female	0.55	5340	0.00 to 1.00
White	0.87	8450	0.00 to 1.00
Asian	0.02	180	0.00 to 1.00
Black	0.05	490	0.00 to 1.00
Latino	0.04	390	0.00 to 1.00
Years of experience	14.80	9.84	0.00 to 40.00
English teacher characteristics			
Female	0.75	7280	0.00 to 1.00
White	0.88	8540	0.00 to 1.00
Asian	0.01	140	0.00 to 1.00
Black	0.06	570	0.00 to 1.00
Latino	0.03	290	0.00 to 1.00
Years of experience	14.27	9.81	0.00 to 40.00
School conditions			
School size in highest quintile	0.23	0.42	0.00 to 1.00
Adequate instructional space	0.21	0.41	0.00 to 1.00

Note: N for Math teacher variables is 10,160. N for English teacher variables is 9710. Ns for proportions presented for a total analytic N of 9710. All Ns rounded to the nearest 10, in accordance with NCES regulations.



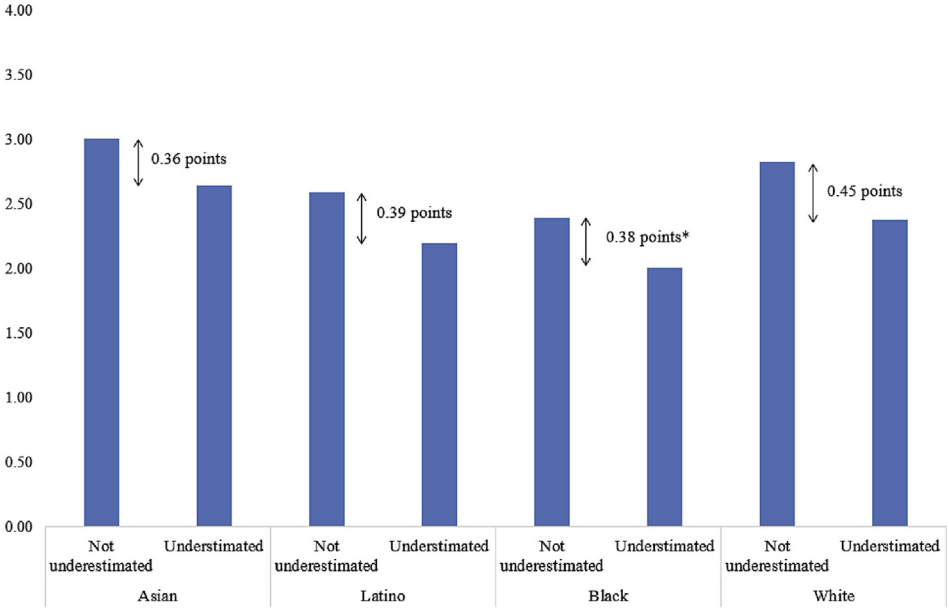
Note: Predicted values are calculated from Table 5, Model 2. Continuous variables set to mean and proportion across categories used for categorical variables.
Note: Asterisks represent statistically significant interaction terms in corresponding models. Therefore, asterisks denote gaps (in expected years) between students that are and are not underestimated within a racial/ethnic group that are different from gaps between underestimated and not underestimated White students.
*** p<0.001, ** p<0.01, * p<0.05

Fig. 1. Predicted years of expected education in 12th grade, by race/ethnicity and math teacher underestimation.



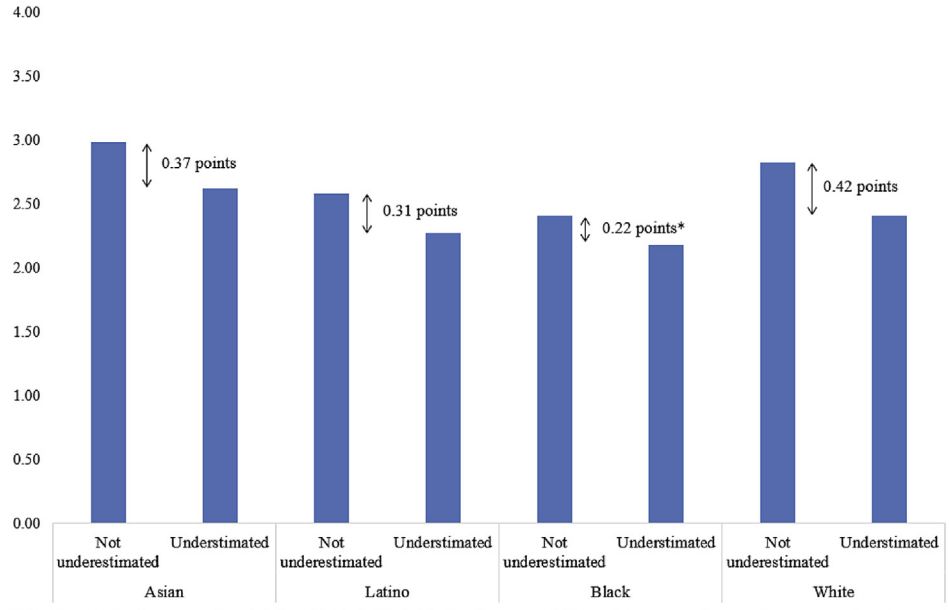
Note: Predicted values are calculated from Table 6, Model 4. Continuous variables set to mean and proportion across categories used for categorical variables.
Note: Asterisks represent statistically significant interaction terms in corresponding models. Therefore, asterisks denote gaps (in expected years) between students that are and are not underestimated within a racial/ethnic group that are different from gaps between underestimated and not underestimated White students.
*** p<0.001, ** p<0.01, * p<0.05

Fig. 2. Predicted years of expected education in 12th grade, by race/ethnicity and english teacher underestimation.



Note: Predicted values are calculated from Table 5, Model 2. Continuous variables set to mean and proportion across categories used for categorical variables.
Note: Asterisks represent statistically significant interaction terms in corresponding models. Therefore, asterisks denote gaps (in GPA) between students that are and are not underestimated within a racial/ethnic group that are different from gaps between underestimated and not underestimated White students.
*** p<0.001, ** p<0.01, * p<0.05

Fig. 3. Predicted GPA in 10th grade, by race/ethnicity and math teacher underestimation.



Note: Predicted values are calculated from Table 6, Model 4. Continuous variables set to mean and proportion across categories used for categorical variables.
Note: Asterisks represent statistically significant interaction terms in corresponding models. Therefore, asterisks denote gaps (in GPA) between students that are and are not underestimated within a racial/ethnic group that are different from gaps between underestimated and not underestimated White students.
*** p<0.001, ** p<0.01, * p<0.05

Fig. 4. Predicted GPA in 10th grade, by race/ethnicity and english teacher underestimation.

References

Aguirre, Jarrad, 2009. Increasing latino/a representation in math and science: an Insider's look. Harv. Educ. Rev. 79 (4), 697–704.
Aguirre, Julia, Speer, Natasha M., 1999. Examining the relationship between beliefs and goals in teacher practice. J. Math. Behav. 18 (3), 327–356.
Ainsworth-Darnell, James W., Downey, Douglas B., 1998. Assessing the oppositional culture explanation for racial/ethnic differences in school performance. Am. Sociol. Rev. 536–553.
Alexander, Karl L., Entwisle, Doris R., Thompson, Maxine S., 1987. School performance, status relations, and the structure of sentiment: bringing the teacher back in. Am. Sociol. Rev. 665–682.
Andrews, Dorinda J. Carter, 2012. Black achievers' experiences with racial spotlighting and ignoring in a predominantly white high school. Teach. Coll. Rec. 114 (10), 1–46.
Baron, Reuben M., Tom, David YH., Cooper, Harris M., 1985. Social class, race and teacher expectations. Teach. Expect. 251–269.
Beady, C.H., Hansell, S., 1981. Teacher race and expectations for student achievement. Am. Educ. Res. J. 18 (2), 191–206.
Beilock, Sian L., Gunderson, Elizabeth A., Ramirez, Gerardo, Levine, Susan C., 2010. Female teachers' math anxiety affects girls' math achievement. Proc. Natl. Acad. Sci. 107 (5), 1860–1863.
Bouchey, H.A., Harter, S., 2005. Reflected appraisals, academic self-perceptions, and math/science performance during early adolescence. J. Educ. Psychol. 97 (4), 673.
Brekelmans, M., Wubbels, T., den Brok, P., 2002. Teacher experience and the teacher-student relationship in the classroom environment. Stud. Educ. Learn. Environ. An Int. Perspective 73–100.
Brophy, J.E., 1983. Research on the self-fulfilling prophecy and teacher expectations. J. Educ. Psychol. 75 (5), 631–661.
Brown, Tara M., 2007. Lost and turned out academic, social, and emotional experiences of students excluded from school. Urban Educ. 42 (5), 432–455. http://dx.doi.org/10.1177/0042085907304947.
Byrnes, James P., 2001. Cognitive Development and Learning in Instructional Contexts. Allyn & Bacon.
Byrnes, James P., 2003. Factors predictive of mathematics achievement in white, black, and hispanic 12th graders. J. Educ. Psychol. 95 (2), 316.
Calafell, Bernadette Marie, 2004. Disrupting the dichotomy:'Yo soy chicana/o?' in the new latina/o south. Commun. Rev. 7 (2), 175–204.
Carter, P.L., 2005. Keepin' it Real. Oxford University Press, USA.
Cherng, Hua-Yu Sebastian, 2017. The Ties that Bind: The Role of Teacher Relationships in the Adaptation of Minority and Immigrant Adolescents. Working Paper.
Cheng, Simon, Starks, Brian, 2002. Racial differences in the effects of significant others on students' educational expectations. Sociol. Educ. 306–327.
Clotfelter, Charles T., Ladd, Helen F., Vigdor, Jacob, 2005. Who teaches Whom? Race and the distribution of novice teachers. Econ. Educ. Rev. 24 (4), 377–392.
Coleman, J.S., 1988. Social capital in the creation of human capital. Am. J. Sociol. 95–120.
Delgado-Gaitan, C., 1988. The value of conformity: learning to stay in school. Anthropol. Educ. Q. 19 (4), 354–381.
Diamond, John B., Randolph, Antonia, Spillane, James P., 2004. Teachers' expectations and sense of responsibility for student learning: the importance of race, class, and organizational habitus. Anthropol. Educ. Q. 35 (1), 75–98. http://dx.doi.org/10.1525/aeq.2004.35.1.75.
Downey, Douglas B., Ainsworth-Darnell, James W., 2002. The search for oppositional culture among black students. Am. Sociol. Rev. 156–164.
Downey, D., Pribesh, S., 2004. When race matters: teachers' evaluations of students' classroom behavior. Sociol. Educ. 77 (4), 267–282.
Ebata, Aaron T., Moos, Rudolf H., 1994. Personal, situational, and contextual correlates of coping in adolescence. J. Res. Adolesc. 4 (1), 99–125.
Farkas, George, 1996. Human Capital or Cultural Capital?: Ethnicity and Poverty Groups in an Urban School District. Transaction Publishers.
Farkas, George, 2003. Racial disparities and discrimination in education: what do we know, how do we know it, and what do we need to know? Teach. Coll. Rec. 105 (6), 1119–1146.
Fennema, Elizabeth, Peterson, Penelope L., Carpenter, Thomas P., Lubinski, Cheryl A., 1990. Teachers' attributions and beliefs about girls, boys, and mathematics. Educ. Stud. Math. 21 (1), 55–69.
Ferguson, Ronald F., 2003. Teachers' perceptions and expectations and the black-white test score gap. Urban Educ. 38 (4), 460–507.
Flores, A., 2007. Examining disparities in mathematics education: achievement gap or opportunity gap? High Sch. J. 91 (1), 29–42.
Foss, Donna H., Kleinsasser, Robert C., 1996. Preservice elementary teachers' views of pedagogical and mathematical content knowledge. Teach. Teach. Educ. 12 (4), 429–442.
Goldhaber, Dan, Lavery, Lesley, Theobald, Roddy, 2015. Uneven playing Field? Assessing the teacher quality gap between advantaged and disadvantaged students. Educ. Res. 44 (5), 207–293.
Guyll, Max, Madon, Stephanie, Prieto, Loreto, Scherr, Kyle C., 2010. "The potential roles of self-fulfilling prophecies, stigma consciousness, and stereotype threat in linking latino/a ethnicity and educational outcomes. J. Soc. Issues 66 (1), 113–130.
Haller, Emil J., 1985. Pupil race and elementary school ability grouping: are teachers biased against black children? Am. Educ. Res. J. 22 (4), 465–483. http://dx.doi.org/10.3102/00028312022004465.
Hallinan, Maureen T., 2008. Teacher influences on students' attachment to school. Sociol. Educ. 81 (3), 271–283.
Heckman, James J., Hidehiko, Ichimura, Petra, Todd, 1998. Matching as an econometric evaluation estimator. Rev. Econ. Stud. 65 (2), 261–294.
Hinnant, J. Benjamin, O'Brien, Marion, Ghazarian, Sharon R., 2009. The longitudinal relations of teacher expectations to achievement in the early school years. J. Educ. Psychol. 101 (3), 662.
Hoy, Wayne K., John Tarter, C., Hoy, Anita Woolfolk, 2006. Academic optimism of schools: a force for student achievement. Am. Educ. Res. J. 43 (3), 425–446.
Hyde, Janet S., Lindberg, Sara M., Linn, Marcia C., Ellis, Amy B., Williams, Caroline C., 2008. Gender similarities characterize math performance. Science 321 (5888), 494–495.
Ingels, S.J., Pratt, D.J., Rogers, J.E., Siegel, P.H., Stutts, E.S., 2004. Education Longitudinal Study of 2002: Base Year Data File User's Manual (NCES 2004-405). US Department of Education. National Center for Education Statistics, Washington, DC.
Irvine, Jacqueline Jordan, 1990. Black students and school failure. Policies, Pract. Prescr. ERIC. http://eric.ed.gov/?id=ED320992.
Jussim, Lee, 2012. Social Perception and Social Reality: Why Accuracy Dominates Bias and Self-fulfilling Prophecy. Oxford University Press.
Jussim, Lee J., Eccles, Jacquelynne, 1995. Are Teacher Expectations Biased by Students' Gender, Social Class, or Ethnicity? http://psycnet.apa.org/psycinfo/2003-88371-010.
Jussim, Lee, Harber, Kent D., 2005. Teacher expectations and self-fulfilling prophecies: knowns and unknowns, resolved and unresolved controversies. Personality Soc. Psychol. Rev. 9 (2), 131–155.
Jussim, Lee, Eccles, Jacquelynne, Madon, Stephanie, 1996. Social perception, social stereotypes, and teacher expectations: accuracy and the quest for the powerful self-fulfilling prophecy. Adv. Exp. Soc. Psychol. 28, 281–388.
Kao, 1995. Asian Americans as model Minorities? A look at their academic performance. Am. J. Educ. 103 (2), 121–159.
Ladson-Billings, Gloria, 1997. It Doesn't add up: african american students' mathematics achievement. J. Res. Math. Educ. 697–708.
Lee, S.J., 1996. Unraveling the" Model Minority" Stereotype: Listening to Asian American Youth. Teachers College Press New York.
Leuven, E., Sianesi, B., 2003. "psmatch2." STATA Module to Perform Full Mahalanobis and Propensity Score Matching, Common Support Graphing, and Covariate Imbalance Testing. version 1, no. 3.
Madon, Stephanie, Smith, Alison, Jussim, Lee, Russell, Daniel W., Eccles, Jacquelynne, Palumbo, Polly, Walkiewicz, Michele, 2001. Am I as you see me or do you see Me as I Am? Self-Fulfilling prophecies and self-verification. Personality Soc. Psychol. Bull. 27 (9), 1214–1224. http://dx.doi.org/10.1177/0146167201279013.
McKown, C., Weinstein, R.S., 2008. Teacher expectations, classroom context, and the achievement gap. J. Sch. Psychol. 46 (3), 235–261.
Mitman, Alexis L., 1985. Teachers' differential behavior toward higher and lower achieving students and its relation to selected teacher characteristics. J. Educ. Psychol. 77 (2), 149.

Munn, Pamela, Lloyd, Gwynedd, 2005. Exclusion and excluded pupils. Br. Educ. Res. J. 31 (2), 205–221.
Polite, Craig K., 1993. Children of the Dream: the Psychology of Black Success. Anchor.
Ready, Douglas D., Wright, David L., 2011. Accuracy and inaccuracy in teachers' perceptions of young Children's cognitive abilities the role of child background and classroom context. Am. Educ. Res. J. 48 (2), 335–360.
Riegle-Crumb, C., Humphries, M., 2012. Exploring bias in math teachers' perceptions of students' ability by gender and race/ethnicity. Gend. Soc. 26 (2), 290–322.
Rist, R.C., 1970. Student social class and teacher expectations: the self-fulfilling prophecy in Ghetto education. Harv. Educ. Rev. 40 (3), 411–451.
Rosenbaum, P.R., Rubin, D.B., 1983. The central role of the propensity score in observational studies for causal effects. Biometrika 70 (1), 41–55.
Rubie-Davies, Christine M., 2006. Teacher expectations and student self-perceptions: exploring relationships. Psychol. Sch. 43 (5), 537–552. http://dx.doi.org/10.1002/pits.20169.
Rubie-Davies, Christine M., Peterson, Elizabeth R., Sibley, Chris G., Rosenthal, Robert, 2015. A teacher expectation intervention: modelling the practices of high expectation teachers. Contemp. Educ. Psychol. Examining Innovations—Navigating Dyn. Complexities School-Based Intervention Res. 40, 72–85. http://dx.doi.org/10.1016/j.cedpsych.2014.03.003. January.
Sanders, Mavis G., 1997. Overcoming obstacles: academic achievement as a response to racism and discrimination. J. Negro Educ. 66 (1), 83–93. http://dx.doi.org/10.2307/2967253.
Sewell, William H., Haller, Archibald O., Portes, Alejandro, 1969. The educational and early occupational attainment process. Am. Sociol. Rev. 82–92.
Skiba, Russell J., Knesting, Kimberly, 2001. Zero tolerance, zero evidence: an analysis of school disciplinary practice. New Dir. Youth Dev. 2001 (92), 17–43.
Sorhagen, Nicole S., 2013. Early teacher expectations disproportionately affect poor Children's high school performance. J. Educ. Psychol. 105 (2), 465–477. http://dx.doi.org/10.1037/a0031754.
Speybroeck, Sara, Kuppens, Sofie, Van Damme, Jan, Van Petegem, Peter, Lamote, Carl, Boonen, Tinneke, Bilde, Jerissa de, 2012. The role of teachers' expectations in the association between Children's SES and performance in kindergarten: a moderated mediation analysis. PloS One 7 (4), e34502.
Steele, C.M., Aronson, J., 1995. Stereotype threat and the intellectual test performance of african Americans. J. Personality Soc. Psychol. J. Personality Soc. Psychol. 69 (5), 797.
Südkamp, Anna, Kaiser, Johanna, Möller, Jens, 2012. Accuracy of teachers' judgments of students' academic achievement: a meta-analysis. J. Educ. Psychol. 104 (3), 743–762. http://dx.doi.org/10.1037/a0027627.
Tabacbnick, B. Robert, Zeichner, Kenneth M., 1984. The impact of the student teaching experience on the development of teacher perspectives. J. Teach. Educ. 35 (6), 28–36.
Tach, Laura Marie, Farkas, George, 2006. Learning-related behaviors, cognitive skills, and ability grouping when schooling begins. Soc. Sci. Res. 35 (4), 1048–1079.
Tenenbaum, H.R., Ruck, M.D., 2007. Are teachers' expectations different for racial minority than for european american Students? A meta-analysis. J. Educ. Psychol. 99 (2), 253–273.
Tuan, M., 1998. Forever Foreigners or Honorary Whites?: the Asian Ethnic Experience Today. Rutgers University Press.
Valdés, G., 1998. The world outside and inside schools: Language and immigrant children. Educ. Res. 27 (6), 4–18.
Weinstein, Rhona S., 2002. Reaching Higher. Harvard University Press.
Wentzel, K.R., 1998. Social relationships and motivation in middle school: the role of parents, teachers, and peers. J. Educ. Psychol. 90 (2), 202–209.
Wilson II, Clint C., Gutiérrez, Félix F., 1995. Race, Multiculturalism, and the Media: from Mass to Class Communication. Sage Publications, Inc.