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Past research extensively documents inequalities in educational opportunity and achievement by students' race/ethnicity or socioeconomic status (SES). Less scholarship focuses on how race/ethnicity and SES interact and jointly contribute to educational inequalities. We advance this burgeoning line of scholarship by charting math achievement trajectories and school socioeconomic composition by both student race/ethnicity and SES in California from 2014-15 through 2017-18. Linked administrative data allow us to operationalize student SES more richly than point-in-time free meal eligibility, a measure commonly used in education research. We find evidence of considerable racial/ethnic disparities in math achievement and school socioeconomic composition among same-SES students. White and Asian students score substantially higher on math achievement tests and attend higher-SES schools than same-SES Hispanic and Black students. Achievement and contextual inequalities are related: differential exposure to school SES by student race/ethnicity is associated with within-SES racial/ethnic achievement disparities. Our findings show that SES does not translate into the same contextual or achievement advantages for students of all racial/ethnic groups, demonstrating the importance of jointly considering student race/ethnicity and SES in future research and policy development.

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Abstract

Past research extensively documents inequalities in educational opportunity and achievement by students' race/ethnicity or socioeconomic status (SES). Less scholarship focuses on how race/ethnicity and SES interact and jointly contribute to educational inequalities. We advance this burgeoning line of scholarship by charting math achievement trajectories and school socioeconomic composition by both student race/ethnicity and SES in California from 2014-15 through 2017-18. Linked administrative data allow us to operationalize student SES more richly than point-in-time free meal eligibility, a measure commonly used in education research. We find evidence of considerable racial/ethnic disparities in math achievement and school socioeconomic composition among same-SES students. White and Asian students score substantially higher on math achievement tests and attend higher-SES schools than same-SES Hispanic and Black students. Achievement and contextual inequalities are related: differential exposure to school SES by student race/ethnicity is associated with within-SES racial/ethnic achievement disparities. Our findings show that SES does not translate into the same contextual or achievement advantages for students of all racial/ethnic groups, demonstrating the importance of jointly considering student race/ethnicity and SES in future research and policy development.

Key words: racial/ethnic achievement gaps; educational inequality; school segregation; socioeconomic status

Racial/ethnic inequalities in educational opportunities and outcomes in the American educational system are well-documented. Past research identifies extensive and persistent racial/ethnic school segregation (Reardon and Owens 2014) and racial/ethnic educational achievement and attainment gaps (Jencks and Phillips 1998; Kao and Thompson 2003). Socioeconomic inequalities in educational opportunities and outcomes have attracted increasing interest in recent years (Bailey and Dynarski 2011; Owens 2018; Reardon 2011), and socioeconomic differences between racial/ethnic groups are often identified as explanations for racial/ethnic educational inequalities.

Less research examines the intersection and interaction of these two key stratifying features. While socioeconomic status (SES) contributes to educational success, it may not translate into the same access to opportunity or lead to comparable outcomes for all racial/ethnic groups. Racialized processes of residential segregation and school choice could lead students of the same SES but different racial/ethnic groups to end up in different residential or school contexts (Conwell n.d.; Owens 2018; Reardon, Fox, and Townsend 2015), and racially stratified phenomena both inside and outside of school—for example, exposure to neighborhood disadvantage (Sharkey 2014) or school discipline (Skiba et al. 2002)—could differentially contribute to same-SES, different-race students' learning processes.

In this study, we take an intersectional empirical approach to examine inequalities jointly constituted by two categories, race/ethnicity and SES (Clarke and McCall 2013; Collins 2015; McCall 2005). We document the math achievement and school contexts of 3rd and 4th graders in California public schools from 2014-15 to 2017-18. Drawing on linked administrative data, we measure SES in two ways—cumulative economic disadvantage and parent education at child's birth—and chart racial/ethnic achievement inequalities between same-SES White, Hispanic,

Black, and Asian students. We find that, while family socioeconomic status accounts for a substantial proportion of racial/ethnic achievement inequalities, sizeable racial/ethnic gaps persist among students from the same socioeconomic background. We then document the socioeconomic composition of schools by students' race/ethnicity and SES and again find substantial within-socioeconomic group racial/ethnic differences. Finally, we show that these differential exposures to school socioeconomic composition are associated with within-SES group racial/ethnic differences. That is, when Black and Hispanic students attend schools with SES composition similar to those of their same-SES White and Asian peers, racial/ethnic differences in math achievement are smaller.

We use the terms gap, difference, and inequality interchangeably when describing achievement or school composition. Following recent research (Carter and Welner 2013; Reardon, Kalogrides, and Shores 2019), we interpret achievement differences as signals of inequality in educational opportunities, and our analyses of school context confirm this perspective. We do not interpret racial/ethnic achievement differences from a deficit perspective implying that one racial/ethnic group lags behind another due to inherent difference. While achievement scores are only one way to measure educational success, they correlate with future outcomes, and they can identify early inequalities where intervention might be needed (Goldhaber, Wolff, and Daly 2020). Overall, our article advances past research on racial/ethnic achievement gaps and school segregation by providing an intersectional perspective to document inequalities jointly produced across race/ethnicity and socioeconomic status.

Achievement Inequalities by Race/Ethnicity and SES

Extensive research documents racial/ethnic inequalities in achievement. The National Assessment of Educational Progress (NAEP) tracks national achievement trends and shows that Black-White achievement gaps in math were smaller in 2012 than the 1970s for 9, 13, and 17 year olds, while Hispanic-White math gaps were smaller for 13 and 17 year olds (National Center for Education Statistics 2013). Black-White and Hispanic-White achievement inequalities, though narrowing, remain substantial, with Black-White disparities generally larger than Hispanic-White disparities (Clotfelter, Ladd, and Vigdor 2009; Magnuson and Waldfogel 2008; Reardon, Robinson-Cimpian, and Weathers 2014). Analyses of standardized tests administered in nearly every district in the country from 2009 to 2013 show that White students outscore Black and Hispanic peers in the same district by roughly 0.5 to 0.7 standard deviations on average, respectively (Reardon et al. 2019). Strikingly, there are almost no districts in the U.S. where Black or Hispanic students outscore White students, on average. Less research reports achievement inequalities between Asian students and other groups, but NAEP long-term trend data on 4th graders' mathematics performance between 1990 and 2019 shows that Asian students increasingly outscore their White peers over time (Hussar et al. 2020).

Research also tracks achievement gap trajectories during students' schooling careers. Black-White gaps widen over the course of elementary school and then remain relatively stable from the end of middle school through high school (Fryer and Levitt 2004; LoGerfo, Nichols, and Reardon 2006). In contrast, Hispanic-White inequalities in math tend to narrow as students progress through elementary school and middle school (Clotfelter et al. 2009; Reardon and Galindo 2009). Asian students begin kindergarten and end third grade with similar levels of math achievement as White students, but by the end of middle school, Asian students outperform their White peers (Reardon et al. 2014).

One prominent explanation for racial/ethnic inequalities in achievement are racial/ethnic differences in SES. While SES is measured in myriad ways, from household income and parent educational attainment to parent occupational status and the number of books in the home, there is a consensus among scholars that family SES differentials shape differences in academic achievement (Fryer and Levitt 2004; Magnuson and Duncan 2006; Roscigno 2000; Yeung and Pfeiffer 2009). Although studies vary in their estimates of the proportion of racial/ethnic achievement inequalities attributable to racial/ethnic SES inequality, most studies concur that SES accounts for a substantial portion (Duncan and Magnuson 2005; Fryer and Levitt 2004). A recent analysis of test scores from nearly all U.S. school districts concluded that roughly 40-50% of the variance in district-level Black-White and Hispanic-White achievement inequalities was explained by racial/ethnic differences in family SES (Reardon et al. 2019). Research also demonstrates that permanent family income (i.e., measured cumulatively throughout childhood) accounts for roughly twice as much of Black-White achievement inequality than current, single-point-in-time measures of income (Rothstein and Wozny 2013). Measures of SES across the life course both improve the accuracy of income measures and acknowledge the cumulative benefits of resources (Michelmore and Dynarski 2017). Moreover, SES differences during early childhood contribute to the large racial/ethnic gaps observed at school entry, emphasizing the importance of accounting for early childhood contexts when examining subsequent educational outcomes (Duncan and Magnuson 2011).

While accounting for SES reduces the magnitude of racial/ethnic achievement inequalities, they nevertheless persist within SES groups. Research on the intersection of racial/ethnic and SES predictors of achievement gaps is relatively rare, but the bulk of existing evidence indicates that Black-White test score disparities are larger at higher SES levels (Conwell n.d.; Lubienski 2002;

Paschall, Gershoff, and Kuhfeld 2018; Yeung and Pfeiffer 2009), though other studies find larger Black-White achievement inequalities among lower income groups (Massey and Brodmann 2014). Even less research examines Asian-other group and Hispanic-other group achievement inequalities by SES—one study presents evidence of large Hispanic-White math inequalities among both poor and non-poor groups and shows that Hispanic-White inequalities narrowed more among non-poor than poor students from 1986 to 2004 (Paschall et al. 2018). These studies, and ours, take an intercategorical approach (McCall 2005), examining how the intersection of multiple pre-defined statuses produce inequalities in reinforcing or contradicting ways (Clarke and McCall 2013; Collins 2015; Tefera, Powers, and Fischman 2018). As we will show, class inequalities may operate differently within racial/ethnic groups and vice-versa, and combinations of both statuses jointly produce consequential patterns of inequality.

Inequality in School Composition and its Role in Student Achievement

One potential explanation for the persistence of racial/ethnic achievement inequalities within SES groups is differential school composition. Research shows that higher-SES school contexts are advantageous for achievement and that schools are highly segregated by both race/ethnicity and SES.

School Socioeconomic Composition and Student Achievement

Scholars have examined the contributions of both racial/ethnic and socioeconomic school composition to students' achievement. School composition may affect achievement through both peer effects and institutional effects. Peer effects accrue as students learn social norms about achievement from their peers or influence peers' outcomes through their behaviors, via disruption, competition, or motivation (Bozick et al. 2010; Figlio 2007; Goldsmith 2011). Institutional effects

operate through the association between a school's composition and its educational opportunities and resources, such as school funding and non-profit fundraising, rigorous coursework, and high-quality teachers (Hanushek and Rivkin 2006; Murray et al. 2019; Rumberger and Palardy 2005; U.S. Government Accountability Office 2016).

The bulk of evidence finds an association between school SES and students' achievement (for reviews, see van Ewijk and Sleegers 2010; Mickelson and Bottia 2009), though there is some debate over the *causal* effects of school socioeconomic composition on achievement. The association between school SES and achievement levels reflects pre-existing achievement differences between high- and low-income students in addition to any effects of attending school with more advantaged peers. Scholars do find associations between achievement *growth* and school SES, though the relationship is less robust than associations between achievement *level* and school SES (Downey, von Hippel, and Hughes 2008; Lauen and Gaddis 2013).

Schwartz (2012) provides experimental evidence that low-income children's achievement growth is larger in higher-income schools. In her study of Montgomery County, students who lived in public housing and who were randomly assigned to low-poverty schools increased their math achievement over time, reducing the socioeconomic achievement gap by half by the end of elementary school. In contrast, public housing resident students randomly assigned to high-poverty schools did not make substantial achievement gains relative to their higher-SES peers. Historical evidence from racial/ethnic desegregation programs also supports the importance of school socioeconomic composition for achievement. These studies find evidence of positive causal effects of school integration on Black students' achievement and suggest that equalizing socioeconomic composition was an important mechanism that equalized school resources (e.g., student-teacher ratios, teacher quality, per-pupil expenditures) and peer SES (Ashenfelter, Collins, and Yoon 2006;

Guryan 2004; Johnson 2019; Reber 2010; Saatcioglu 2010). Reardon (2016) considers racial/ethnic and socioeconomic school segregation jointly and finds that, net of differences in racial/ethnic groups' economic statuses, racial/ethnic differences in exposure to school poverty contributes greatly to racial/ethnic achievement inequalities.

Associations between achievement and school composition may differ by student racial/ethnic and SES group (Halpern-Manners 2016; Langenkamp and Carbonaro 2018; Ryabov and Van Hook 2007). These associations may also vary over a student's school career—effects may be lagged or cumulative, or may matter more at some grades than others (Halpern-Manners 2016; Langenkamp and Carbonaro 2018; Mickelson and Bottia 2009; Schwartz 2012). Therefore, in our analyses, we allow the association between school SES composition and achievement to vary by grade, race/ethnicity, and student SES.

School Segregation by Race/Ethnicity and Class

Past research shows that schools are highly segregated by both race/ethnicity and socioeconomic status (Owens, Reardon, and Jencks 2016; Reardon and Owens 2014). One consequence is that students of different racial/ethnic backgrounds are differentially exposed to school poverty, since Black and Hispanic students tend to have, on average, lower family incomes than White and Asian students. In 2015-16, most White and Asian students attended low-poverty schools (<50% free or reduced price lunch (FRPL) eligible), while most Black and Hispanic students attended high-poverty schools (>50% FRPL eligible) (McFarland et al. 2018). The average White and Asian student attended school where about 35% of peers were FRPL-eligible, compared to about 60% in the average Black or Hispanic student's school (Owens 2020).

Economic inequalities between racial/ethnic groups contribute to where students live and attend school and, thus, their school composition. However, it is likely that, even accounting for

economic status, Black and Hispanic students attend lower-SES schools than White or Asian students. Studies of neighborhood inequality show that Black households live in lower-income neighborhoods than White households with similar incomes (Logan 2011; Reardon et al. 2015). For example, in 2009, high-income White households lived in neighborhoods at the 64th percentile of the neighborhood income distribution, compared to the 57th, 60th, and 70th percentile for high-income Black, Hispanic, and Asian households, respectively (Reardon et al. 2015). Racially disparate neighborhood outcomes occur because of racial/ethnic discrimination and prejudice in the housing market, racial/ethnic differences in wealth, and racially stratified preferences and information about neighborhoods (Pattillo 2005). Moreover, unlike White middle-income neighborhoods, Black middle-income neighborhoods tend to be geographically proximate to lower-income neighborhoods (Sharkey 2014), and schools may serve areas larger than a single neighborhood.

Given the link between neighborhoods and schools, via both school assignment processes and the weight parents place on proximity when choosing schools, the same pattern of racial/ethnic inequality within SES groups likely holds for school composition. We hypothesize that Black and Hispanic students attend lower-SES schools than White and Asian students of similar SES backgrounds. Some research shows this is the case for Black-White inequalities. Conwell (n.d.) finds that at all income levels, Black students attend school with more economically disadvantaged peers than same-income White students, and in 2009, this racial/ethnic disparity in school composition was largest for highest-income students. Owens (2018) provides district-level evidence, showing that, in most metropolitan areas, the average high-income Black family lived in a lower-income school district than similarly high-income White families. In fact, in the most segregated metropolitan areas, *low-income* White families lived in higher-income districts than

high-income Black families. Economic resources do not translate into access to opportunity in the same way for Black and White families, so approaches that consider multiple status dimensions are critical for identifying inequalities.

Examining Racial/Ethnic by SES Math Achievement in California

In this study, we examine math achievement trajectories from 3rd through 7th grade for two cohorts of California students from 2015 through 2018. We build on past scholarship by addressing three research questions:

(1) What is the extent of racial/ethnic inequalities in math score trajectories for elementary school students *within* SES groups?

(2) Comparing same-SES students, how large are racial/ethnic differences in school socioeconomic composition?

(3) Do racial/ethnic inequalities in school socioeconomic composition account for racial/ethnic achievement inequalities within SES groups?

Addressing the first question contributes to the literature by documenting racial/ethnic achievement inequalities among Black, Hispanic, Asian, and White students within SES groups, drawing on two different SES measures—one cumulative across the school career, and one measuring parent educational level in early childhood. We provide an account of test score trajectories over five grades, four racial/ethnic groups, and eight SES groups. Then, we advance the segregation literature by identifying intersectional inequalities in school composition—racial/ethnic inequalities among same-SES students in school socioeconomic composition. Finally, we provide evidence that differential school SES composition is one reason why racial/ethnic by SES achievement inequalities persist—SES translates to different contextual

advantages for some racial/ethnic groups than others, with consequences for achievement. Throughout analyses, we quantitatively examine the intersection of race/ethnicity and class, allowing heterogeneous effects across statuses to acknowledge the different ways that class advantages or disadvantages can accrue within racial/ethnic groups (McCall 2005; Schudde 2018).

Data and Measures

To answer these research questions, we draw on statewide vital birth records from the California Department of Public Health (CDPH) and public school records from the California Department of Education (CDE). The dataset was constructed by probabilistically linking public school records to birth records using an open source machine learning algorithm trained on California data, conducted by staff at the Children's Data Network at the University of Southern California (https://www.datanetwork.org/). Data were available for research purposes through active data sharing agreements. All linkages and analyses were governed by strict data security protocols and reviewed by state and university human subject boards. The final analytic dataset was constructed by using birth records to identify all children born in California between September 1, 2004 and September 1, 2006. We analyze data for all CA public school students in 3rd or 4th grade in the 2014-15 school year.

Student Achievement

We predict math achievement scores on the CA Smarter Balance Summative Assessment from 2014-15 through 2017-18.[1] The Smarter Balance Summative Assessment is vertically scaled over grades to facilitate assessment of growth. Table 1 presents mean achievement in 3rd grade and

[1] We observe two cohorts over four years: one from 3rd to 6th grade and one from 4th to 7th grade. The Smarter Balance Summative Assessment is first administered in 3rd grade; we begin analyses in 2014-15 for both cohorts because CA did not administer achievement tests in 2013-14.

mean annual growth across the four years by racial/ethnic group. White and Asian students score higher in 2014-15 and have larger growth rates than Black or Hispanic students.

[Table 1 here]

Student Race/Ethnicity

We limit our sample to four racial/ethnic groups defined by the CDE, accounting for 99% of CA 3rd and 4th graders in 2014-15: Hispanic, non-Hispanic White, non-Hispanic Black, and non-Hispanic Asian (N = 997,482 students).[2] We do not estimate achievement of the excluded racial/ethnic groups (Pacific Islander and American Indian/Alaska Native students), but we account for all students when measuring school composition. Racial/ethnic identifiers were missing for around 2,000 students (0.2% of the sample), and we assign these students their mothers' race/ethnicity from their birth record (or father's race/ethnicity, if mother's race/ethnicity is missing). Racial/ethnic identifiers remained missing for 0.09% of the sample; we drop these observations. The majority of students in our sample are Hispanic, as Table 1 shows.

Family Socioeconomic Status

We measure students' family SES in two ways. First, we classify mother's educational attainment at the time of the student's birth into four categories—less than HS degree, HS degree, some college, or BA or more. If mother's education is not available, we substitute father's education. Parent education at the student's birth is obtained from vital birth records and was missing for 23% of students—either students not born in CA or those with missing data on the birth record. We use multiple imputation to impute these values, adding 5 imputed datasets. We run the imputation model separately by race/ethnicity, given our use of interaction terms in the

[2] Asian includes students from Chinese, Japanese, Korean, Vietnamese, Asian Indian, Laotian, Cambodian, Hmong, Filipino, and other Asian backgrounds. Student SES and achievement vary within all racial/ethnic groups, including pan-ethnic groups like Hispanic and Asian. We do not analyze pan-ethnic subgroups; this is an important area for future research.

analysis. We include the dependent variable in our imputation model, but we do not impute it (test scores are only missing when students were not tested in a given year) (von Hippel 2007). Table 1 shows that parent education varies by students' race/ethnicity. Parents of White and Asian students predominantly have at least a BA, whereas over 50% of Black and 75% of Hispanic students' parents did not attend college.

Second, following Michelmore and Dynarski (2017), we estimate a cumulative socioeconomic disadvantage (SED) rate as the proportion of years a child was categorized as SED from kindergarten (2010-11 or 2011-12) through the end of our sample period (6^{th} or 7^{th} grade, depending on cohort). As described above, permanent income is more strongly associated with student outcomes than point-in-time measures. We create four SED categories: never SED, SED 1-49% of years observed, SED 50-99% of years observed, and always SED. The CDE defined SED as "students where both parents/guardians have not received a high school diploma; or students who are eligible for the free or reduced-price meal (also known as the National School Lunch Program)" through 2013-14. Starting in 2014-15, in addition to these two criteria, SED also includes students with "a direct certification for free or reduced-price meals; or students who are migrant, homeless, or foster youth." Table 1 shows that, on average, White and Asian students were SED for about 1/3 of observed school years, while the cumulative SED rate was nearly 75% and over 80% for Black and Hispanic students, respectively. Nearly half of Black and two-thirds of Hispanic students were SED in all observed school years since kindergarten, compared to 16% and 20% of White and Asian students, respectively. In contrast, over half of White and Asian students were never SED, compared to less than 15% of Black or Hispanic students.

Our two SES measures are related but distinct. SED incorporates parent education, but it is a more holistic measure, including parent education, family income, and other disadvantaged

statuses. Further, we measure parent education at child's birth, so it better captures SES in early childhood, while cumulative SED is a multidimensional measure of school career SES. These two measures of SES are correlated with one another but vary, especially by race/ethnicity. On both measures, student SES is bifurcated by race/ethnicity, with Asian and White students being more advantaged, on average, than Black and Hispanic students. However, parent education confers different economic advantages depending on race/ethnicity. Table 1 shows that Black and Hispanic college-educated parents have mean cumulative SED rates comparable to White and Asian parents with only some college, and Black and Hispanic parents with some college education have mean cumulative SED rates more similar to White and Asian parents who are high school dropouts. Parent education translates to economic resources differently for different racial/ethnic groups, emphasizing the importance of an intersectional approach that considers SES and race jointly.

Methods

We aim to describe racial/ethnic inequalities in math achievement in CA for 3rd and 4th grade cohorts starting in 2014-15 through 2017-18. Our basic model for estimating math achievement trajectories is:

$$Y_{it} = \alpha + \beta_k race_i + \beta_k grade_{it} + \beta_k race_{ik}\ x\ grade_{it} + \beta_1 cohort_i + \beta_2 female_i + \varepsilon_{it} \qquad (1)$$

Where Y_{it} is math score for student *i* in year *t*, *race* is a vector of *k=3* dummy variables for Black, Hispanic, and Asian, with White as the reference group, *grade* is a vector of *k* dummy variables for student's grade in year *t* (with 3rd grade as the reference), *cohort* = 1 for 4th grade (versus 3rd grade) cohort, and *female* = 1 if the student is female (versus male). The interaction of *race x grade* allows achievement trajectories across grades to vary by race. We cluster error terms by student in all models. Because our models rely on interaction terms, we present estimated marginal effects

rather than coefficients, and we focus on direction and magnitude of associations rather than significance given the large sample size and our observation of the full universe of CA students (almost all coefficients are highly statistically significant; a few individual interaction terms in later models do not reach significance, though groups of interaction terms are jointly significant).

We next estimate models that add vectors of *k=3* dummy variables for each SES measure, either the four-category SED measure (never SED is the reference group) or parent education measure (less than high school is the reference group). We include *race x grade* and *SES x grade* interactions, allowing the grade trajectory to vary by race/ethnicity and by SES, respectively. We also include *race x SES* interactions and *race x grade x SES* interactions, allowing math trajectories by race to vary by SES. We model associations with each SES measure (parent education or SED category) separately and then consider them simultaneously; Equation 2 represents this full model. We present marginal estimates from these models to examine (1) the magnitude of racial/ethnic gaps once we control for SES; and (2) the magnitude of racial/ethnic gaps within SES groups.

$$Y_{it} = \alpha + \beta_k race_i + \beta_k grade_{it} + \beta_k race_i \; x \; grade_{it} + \beta_1 cohort_i + \beta_2 female_i + \beta_k SED_i + \beta_k SED_i \; x \; grade_{it} + \beta_k SED_i \; x \; race_i + \beta_k SED_i \; x \; grade_{it} \; x \; race_i + \beta_k PEd_i + \beta_k PEd_i \; x \; grade_{it} + \beta_k PEd_i \; x \; race_i + \beta_k PEd_i \; x \; grade_{it} \; x \; race_i + \varepsilon_{it} \quad (2)$$

To answer research question 2, we estimate the average school socioeconomic composition for students of different racial/ethnic and SES groups. We estimate weighted averages of, for example, the proportion of never-SED students in a Black student's school (equivalent to exposure measures in the segregation literature). Our measure of school composition includes all students in the 3rd and 4th grade cohort in 2014-15. Therefore, we account for the family background of peers in one's own grade and, depending on cohort and year, the grade above or below if present in the school. Because we follow cohorts over time, our school composition measure in some years may only capture peers in one's own grade if, for example, the 4th grade cohort moves on to middle

school while the 3rd grade cohort stays in elementary school. We have no reason to think that the composition of one's own (or one's own and one surrounding grade) should differ starkly from the composition of all grades in the school. We compare average school SES composition across racial/ethnic groups for students in the same SES groups (e.g., comparing the school SES composition of Hispanic and White children of BA-educated parents).

Finally, to address research question 3, we add measures of school SES composition to the regression models above. We estimate mean SES composition of each school in each year in two ways: mean cumulative SED rate and mean parent BA rate of all students (results are similar if we use mean parent HS dropout rate instead of BA rate). We model interaction terms between school socioeconomic composition and race/ethnicity, grade, and student SES, to allow trajectories to vary across race/ethnicity and SES groups. We present marginal estimates from models to show how racial/ethnic gaps within SES groups are associated with differential school SES composition.

Results

Racial/Ethnic Inequalities in Math Achievement within SES Groups

There are large racial/ethnic achievement inequalities that persist across grades. Table 2, top panel, presents mean racial/ethnic gaps in math achievement for each grade, estimated from equation (1). We compare non-White to White students to be consistent with most past research on achievement inequality that acknowledges the social, economic, and political advantages White students possess and to have one consistent comparison group. Asian students outscored White students by over 25 points, with a growing advantage across grades. White students scored higher than Black and Hispanic students, with inequalities increasing (becoming more negative) across grades. Black-White and Hispanic-White gaps were about 50% larger in 7th than 3rd grade. The

standard deviation of the scale score in 3rd grade was between 74 and 80 points for all students, so by 7th grade, White students were outscoring Black and Hispanic students by about a standard deviation or more and Asian students were outscoring White students by about 2/3 of a standard deviation.

[Table 2 about here]

The lower panels of Table 2 present percent differences in the estimated scale score gaps across models, comparing results from equation (1) above to results from models that include parent education categories, SED categories, and then both parent education and SED categories (equation (2) above). These models include three-way interactions (and all constitutive terms) between grade, race/ethnicity, and SES, allowing both initial achievement levels and trajectories to vary. For example, the first row of the "Parent Ed" panel indicates that controlling for parent education reduced 3rd grade Black-White achievement inequality by 30% and Hispanic-White achievement inequality by 54%. For Black-White and Hispanic-White achievement inequality, results are fairly consistent across grades—parental education differences account for 30-32% of achievement inequality between White and Black students and 54-61% of achievement inequality between White and Hispanic students.

The "SED" panel of Table 2 indicates that cumulative socioeconomic disadvantage rate accounts for an even greater proportion of Black-White and Hispanic-White achievement inequality than parental education—around 45 and 63%, respectively, across grades. Comparing the two SES measures, parent education may explain less of the observed racial/ethnic gaps in math achievement than cumulative SED because, as discussed above, Table 1 shows that parent education translates into economic status differently for White than for Black and Hispanic students. The average White child of a college-educated parent is SED only 8% of school years,

compared to 34% for the average Black or Hispanic child of a college-educated parent. Highly-educated Black or Hispanic parents in our sample are still often economically disadvantaged and may be unable to afford housing in advantageous neighborhoods, enrichment activities, or other expenditures that promote achievement. The bottom panel of Table 2 shows that accounting for both parent education and cumulative SED explains an even greater proportion of Black-White and Hispanic-White achievement inequality.

White-Asian inequality operates differently. First, Asian students outperform White students, on average, unlike Black or Hispanic students. Second, accounting for SES *increases*, rather than reduces, Asian-White achievement inequality in most grades. Comparing Asian and White children with similar parent education and SED rates, Asian students' achievement advantage over White children is between 7 and 17% higher across grades (bottom panel). Third, family SES accounts for a greater proportion of achievement inequality from 3rd to 7th grade, perhaps through middle school selection or intensified educational supports or enrichment in later grades.

We next present the racial/ethnic achievement inequalities that *persist* within SES groups. Figure 1 presents predicted achievement trajectories by race/ethnicity from separate models that include SED (left panel) and parent education (right panel) and their three-way interactions with race/ethnicity and grade.

[Figure 1 here]

Racialized achievement patterns persist within SES categories. The order of achievement in all SES categories and grades is Asian, White, Hispanic, and Black. Moreover, racial/ethnic inequalities increase from 3rd to 7th grade within nearly all SES groups—Asian and White students have larger achievement growth trajectories than Black and Hispanic students. Hispanic-White

achievement inequalities are larger among the highest-SES groups, never-SED and college-educated, than the lowest-SES groups, and achievement inequalities also increase more from 3rd to 7th grade among the highest-SES students. In fact, Hispanic-White inequalities *decline* among children of non-high school graduates from 3rd to 7th grade. Seventy-five percent of Hispanic children of non-high school graduates are designated as English Language Learner (ELL) in at least one year that we observe of their school career (compared to 14% of White children of non-high school graduates), so these gains could reflect rapid acquisition of English language skills.[3]

Black-White achievement gaps are of similar magnitude and growth among SED categories, but Black-White gaps are twice as large and grow more across grades among children of BA-educated parents than high school dropouts. Larger racial/ethnic achievement gaps in higher-SES groups is consistent with past research exploring race/ethnicity by class achievement disparities (Conwell n.d.). This finding emphasizes that higher-SES Black and Hispanic students do not enjoy the same benefits as higher-SES White students—class advantages accrue differently across racial/ethnic groups. For example, higher-SES Black or Hispanic students may not attend the same types of schools as high-SES White students, as we explore in the next section.

Asian students outperform all other students within all SES groups, and their achievement advantage over White students is slightly larger in the *lowest*-education groups (high school dropouts). Asian-White differences increase over grades in all SES categories, with the steepest growth among the most disadvantaged students (always SED and non-high school graduates). Again, this could be due to rapid English language acquisition, as 73% of Asian children of non-high school graduates are classified as ELL in at least one year that we observe of their school career (and in 78% of school years, on average).

[3] The proportion of Hispanic children ever designated ELL is lower for children of more highly-educated parents: 48% of children of high school graduates, 35% of parents with some college, and 26% of children of college graduates.

Together, Table 2 and Figure 1 indicate that racial/ethnic achievement inequalities are large and grow across elementary grades. While family SES accounts for a considerable amount of Black-White and Hispanic-White achievement inequality, inequalities persist within SES groups and are often larger among higher-SES than lower-SES groups. Further, cumulative SED rate accounts for more of Black-White and Hispanic-White achievement inequality than parent education, likely because parent education does not translate into the same economic advantages for Black and Hispanic parents as White and Asian parents.

Racial/Ethnic and Socioeconomic Inequalities in School Composition

Our results indicate that SES accounts for a substantial portion of racial/ethnic achievement inequality, but racial/ethnic inequalities persist and grow within SES groups. We hypothesize that racial inequalities in school composition, in addition to achievement, persist within SES groups. School context is one pathway through which family SES matters for achievement—whether through purchasing housing in a particular school zone or choosing a particular school, higher-SES students are likely to attend school with other high-SES peers, which may be advantageous. However, the association between family SES and school SES may vary by race. As previous research shows for neighborhood and school district residence (Owens 2018; Reardon et al. 2015), high-income Black and Hispanic families may not access the same contexts as similarly high-income White families. We explore these racial/ethnic-by-SES inequalities here.

[Figures 2a and 2b here]

We begin by describing the average SES composition of Asian, Black, Hispanic, and White students' schools. Figures 2a and 2b present the SED and parent education composition, respectively, of the average student's school by student race/ethnicity in 2018 (results for all years are available in Appendix Table 1; patterns are stable). Consistent with past research, we find that

Black and Hispanic students attend much more socioeconomically disadvantaged schools than White or Asian students. Using cumulative SED measures rather than point-in-time free or reduced meal eligibility provides a more nuanced account than past research. The average Asian or White student attends school where 44% of peers were never SED in their school careers, while the average Black or Hispanic student attends school where half or more of peers were always SED. Similarly, the average White or Asian student attends school where nearly 40% of peers' parents were college-educated compared to less than 20% for Black or Hispanic students. The average Black or Hispanic student attends school where 33% and 42%, respectively, of peers' parents did not graduate from high school.

These inequalities in school SES context arise from (a) Black and Hispanic students' families' lower SES, on average; (b) racial/ethnic segregation between schools; and (c) socioeconomic segregation between schools. Appendix Figure 1 shows that, like the average U.S. student, CA students were racially isolated in 2018, attending school with a disproportionate share of one's own racial/ethnic group. Appendix Figure 2a presents school SES segregation; in 2018, the average never-SED student attended school where 54% of peers were also never SED, even though only 26% of our sample is never SED. Conversely, the average always-SED student attended school where 61% of peers were also always SED, compared to 45% in the sample. Similar isolation is evident for parent education (Appendix Figure 2b).

[Figures 3a and 3b here]

Figures 3a and 3b present the SES composition of students' school by race/ethnicity-by-SES in 2018 (Appendix Tables 2-3 present results for all years). Higher-SES students of all racial/ethnic groups attended higher-SES schools than their same-race/ethnicity, lower-SES peers. However, within each SES category, Black and Hispanic students attend lower-SES schools than

White and Asian students. Even high-SES Black and Hispanic students attend lower-SES schools than their same-SES White and Asian peers. For example, Figure 3a shows that, among students who were never SED, Asian and White students attend schools where, on average, more than 55% of peers were also never SED. In contrast, Black and Hispanic never-SED students attend schools where, on average, only about 40% of peers were never SED and more than 50% of peers were SED for the majority of their school careers. Always-SED Asian and White students attend schools that look like the schools that 50-99% SED Black and Hispanic students attend. Among students with college-educated parents, Asian and White students attend school where nearly half of peers also have college-educated parents, compared to only about 30% of peers for Black and Hispanic children of college graduates (Figure 3b). Asian and White children of high school dropouts attend schools that look like those of Black and Hispanic children of parents with some college education.

These analyses show that CA students are substantially segregated by race/ethnicity and socioeconomic composition, and these statuses intersect and interact to contribute to racial/ethnic inequality in school composition within SES groups. We move beyond past research to show that racial/ethnic inequalities in school SES composition persist within SES groups. High-SES Hispanic and Black students attend lower-SES schools than economically similar Asian and White students, and conversely, low-SES White and Asian students attend schools similar to higher-SES Black and Hispanic students.

The Association between School SES Composition and Math Achievement

These racial/ethnic inequalities in school composition within SES groups may account for the persistent racial/ethnic achievement differences within SES groups that we documented in Figure 1. We return to these prior results and examine the degree to which racial/ethnic achievement gaps within SES groups persist once we control for school SES. Figure 4 presents

within-SED group math achievement inequalities. The dashed lines replicate Figure 1. The solid lines show racial/ethnic achievement inequalities after controlling for school mean cumulative SED rate. Table 3 presents the mean racial/ethnic scale score gap within each SED category (top panel), and then the percent reduction in that within-SED group gap (the difference between the dashed and solid lines) when we control for school mean cumulative SED rate. Table 3 presents averages across grades for parsimony. While we allow grade trajectories to vary by school SES, most trend lines in Figures 4 and 5 are fairly parallel, indicating that school SES is associated with the level of achievement more than its trajectory across grades.

[Figure 4 here]

[Table 3 here]

Accounting for school mean cumulative SED rate reduces Black-White and Hispanic-White achievement inequalities within SED groups—the gray solid lines are closer to zero than the dashed lines. Black-White achievement differences are 14-22% lower and Hispanic-White differences are 24-38% lower among Black and Hispanic students who attend schools that have the same SES composition as their same-SES White peers. Controlling for school SED rate reduces within-SED group racial/ethnic achievement inequalities more for some SED groups and racial/ethnic dyads than others. The differences are due to differences in school composition inequalities and differences in relationships between school composition and achievement among groups. For never-SED students, controlling for school SES reduces Asian-White inequalities in White students' favor because Asian never-SED students attend schools with higher mean school SED rates than White never-SED students (Appendix Table 2). For the other three SED groups, controlling for school cumulative SED rate either changes Asian-White inequality little or

increases the gap because in these SED groups, Asian students have higher school SED rates than White students.

[Figure 5 here]

Figure 5 repeats the exercise for parent education group, examining how schools' parent BA rates account for within-SES racial/ethnic inequalities. Again, we see that racial/ethnic inequalities in school SES account for a portion of the persistent Hispanic-White and Black-White achievement gaps within parent education group—the gray solid lines are closer to zero than the dashed lines within all parent education groups. Table 3, bottom panel, shows that controlling for school parent BA rate reduces within-SES group Hispanic-White inequalities by between 23-44%, more than the reduction for Black-White inequalities (15-27%). Controlling for school parent BA rate changes Asian-White inequality only trivially for students whose parents did not attend college. For children of college graduates, controlling for school BA rate reduces the Asian-White gap—again, the most advantaged Asian students (here, children of college graduates) attend higher-SES schools than White students (Appendix Table 3), so controlling for school BA rate reduces the Asian-White gap.

Our results show associations between school composition and student achievement, but we cannot distinguish between causal effects of school composition or selection into schools with certain compositions. That is, higher-achieving Black students may be more likely than lower-achieving Black students to select schools with similar SES composition as their same-SES White peers; or school SES composition may exert an effect on students' achievement so that when Black students attend similar schools to White peers, racial/ethnic achievement inequalities decline. Both processes are likely operating to some extent. More broadly, we find that Black and Hispanic students do not have the same access to high-SES schools as their same-SES White and Asian

peers, so to the extent that high-SES schools provide advantages in learning, networking, curricula, social experiences, or other school resources, within-SES racial/ethnic inequality exists, which may shape achievement or other future outcomes.

In sum, our results show that (1) racial/ethnic achievement inequalities persist and often grow among same-SES students; (2) Black and Hispanic students attend lower-SES schools than same-SES White and Asian peers; and (3) when Black and Hispanic students attend schools with similar SES composition as their same-SES White peers, racial/ethnic achievement inequalities are lower.

Discussion

Race/ethnicity and class are two key stratifying forces in education that mutually constitute one another in complex ways, and our study contributes to the literature demonstrating the importance of jointly documenting racial/ethnic and SES inequalities in both educational opportunities and outcomes. We find that racial/ethnic inequalities in math score trajectories for California elementary school students are large and persist within SES groups, with the order of average achievement being Asian, White, Hispanic, and Black. Hispanic-White and Black-White achievement gaps are larger and grow more among higher-SES students. Asian students outscore White students across SES groups, and the gaps widen across grades, especially for the lowest-SES students. We advance the existing "achievement gap" literature by documenting differential achievement trajectories among four racial/ethnic groups within eight socioeconomic groups. Our SES measures improve upon point-in-time FRPL measures often used in past research (though measures remain coarse due to data availability).

One explanation for persistent racial/ethnic achievement gaps within SES groups is that family SES translates into more advantaged school contexts among Asian and White students than among Black and Hispanic students. Not only do Black and Hispanic students attend lower-SES schools than White and Asian students, as past research shows, but these inequalities persist after controlling for students' own family background. For example, Hispanic or Black students who were never socioeconomically disadvantaged attend school where around half of peers were SED for the majority of their school careers. In contrast, Asian and White never-SED students attend school where only 30% of students were frequently SED. We find that racial/ethnic inequalities in school socioeconomic composition are associated with Hispanic-White and Black-White inequalities within SES groups. The association between school SES and achievement varies across SES measure, SES group, and student race/ethnicity, depending on the extent of the racial/ethnic inequalities in school composition within each SES group and its relationship with achievement. Asian-White inequalities are actually exacerbated by accounting for school SES for lower-SES groups, since lower-SES White students attend higher-SES schools than comparable Asian students.

We argue that racialized stratification processes that contribute to racial/ethnic inequalities in achievement persist within socioeconomic groups. First, we show that parent education translates into economic status differently by race. White and Asian children with college-educated parents are much less likely to be socioeconomically disadvantaged than Black and Hispanic children of college-educated parents. Whether because of job discrimination, family structure, difference in college quality, or other racially stratified factors that predict household income, Black and Hispanic families may be less able to translate parent education into benefits for their children. Second, we find that both parent education and cumulative socioeconomic disadvantage

are associated with school SES composition differently by student race. Residential segregation or school choice processes that operate differentially by race/ethnicity result in children from similar socioeconomic backgrounds but different racial/ethnic groups attending schools with different socioeconomic compositions. Both school and non-school factors likely contribute to the intersectional achievement inequalities that we document.

Our empirical intersectional approach is intercategorical (McCall 2005), relying on pre-established categories in quantitative data and examining the relationships among these categories. Our data permit comparisons among four racial groups, including Asian students who are often excluded from achievement disparity research. However, racial/ethnic categories are socially constructed, and the Asian and Hispanic categories, in particular, include groups with very different immigration histories and assimilation patterns. Future research should examine within-group variations, as well as achievement for Pacific Islander and American Indian students, who we exclude. Access to individual data facilitates our intercategorical approach—for example, the school segregation literature often relies on administrative school-level data (e.g., the Common Core of Data) that does not provide data tabulated by race-by-class, so most scholarship considers racial/ethnic and economic segregation separately (Reardon and Owens 2014). While we provide one type of intersectional account, additional methodologies and theoretical approaches to studying intersectionality taken up in future research will enrich our understanding of the complex inequalities in school composition and student achievement.

We focus on one state, which limits analyses to children experiencing the same state-level policies that may contribute to achievement. Results for California may not hold in other parts of the country where racial/ethnic diversity, immigrant assimilation, cost of living, and state-level policies (among other factors) produce different patterns of segregation and inequality. However,

about 12% of public schoolchildren in the U.S. live in California, and demographic changes in California often foretell future changes in the rest of the country. Therefore, lessons from California are instructive. We do not examine inequality between districts *within* California; this is another important task for future research.

Our results contribute to the knowledge base for policymakers. Following the *Brown v. Board of Education* Supreme Court decision (1954) and subsequent court cases in the 1960s, many school districts were subject to mandatory racial/ethnic desegregation orders (or undertook them voluntarily). In recent decades, many of those desegregation orders have expired as districts reached an acceptable level of racial integration (Reardon et al. 2012). More recent integration programs, often voluntary, focus on socioeconomic integration, especially following the *Parents Involved* Supreme Court decision (2007) that prevents the consideration of race/ethnicity in district integration plans (Reardon and Rhodes 2011). Our results show that students may be best served by considering race/ethnicity and SES jointly in any student assignment plans. Black and Hispanic students attend lower-SES schools than White and Asian students at all SES levels, so evaluating integration on only one metric may mask inequalities within SES groups or within racial/ethnic groups.

Overall, we draw on a unique linked administrative dataset to provide a picture of intersectional inequality in educational opportunity and outcomes by student race/ethnicity and class. Future studies of segregation and student achievement would be well-served considering race/ethnicity and SES jointly, and future data collection efforts should also prioritize making race-by-SES data available. Only an examination of multiple stratifying forces provides a complete picture of inequality in the American education system.

Works Cited

347 U.S. 483. 1954. *Brown v. Board of Education*.

551 U.S. 701. 2007. *Parents Involved in Community Schools v. Seattle School District No. 1*.

Ashenfelter, Orley, William J. Collins, and Albert Yoon. 2006. "Evaluating the Role of Brown v. Board of Education in School Equalization, Desegregation, and the Income of African Americans." *American Law and Economics Review* 8(2):213–48.

Bailey, Martha J. and Susan M. Dynarski. 2011. "Inequality in Postsecondary Education." Pp. 117–32 in *Whither Opportunity? Rising Inequality, Schools, and Children's Life Chances*, edited by G. J. Duncan and R. J. Murnane. New York, NY: Russell Sage Foundation.

Bozick, Robert, Karl Alexander, Doris Entwistle, Susan Dauberand, and Kerri Kerr. 2010. "Framing the Future: Revisiting the Place of Educational Expectations in Status Attainment." *Social Forces* 88:2027–52.

Carter, Prudence L. and Kevin G. Welner. 2013. *Closing the Opportunity Gap: What America Must Do to Give Every Child An Even Chance*. New York: Oxford University Press.

Clarke, Averil Y. and Leslie McCall. 2013. "Intersectionality and Social Explanation in Social Science Research on Race." *Du Bois Review: Social Science Research on Race* 10(2):349–63.

Clotfelter, Charles T., Helen F. Ladd, and Jacob L. Vigdor. 2009. "The Academic Achievement Gap in Grades 3 to 8." *The Review of Economics and Statistics* 91(2):398–419.

Collins, Patricia Hill. 2015. "Intersectionality's Definitional Dilemmas." *Annual Review of Sociology* 41:1–20.

Conwell, Jordan A. n.d. "Diverging Disparities: Race, Parental Income, and Children's Math Scores, 1960-2009." *Sociology of Education*.

Downey, Douglas B., Paul T. von Hippel, and Melanie Hughes. 2008. "Are 'Failing' Schools Really Failing? Using Seasonal Comparison to Evaluate School Effectiveness." *Sociology of Education* 81(3):242–70.

Duncan, Greg J. and Katherine A. Magnuson. 2005. "Can Family Socioeconomic Resources Account for Racial and Ethnic Test Score Gaps?" *Future of Children* 15(1):35–54.

Duncan, Greg J. and Katherine A. Magnuson. 2011. "The Nature and Impact of Early Achievement Skills, Attention Skills, and Behavior Problems." Pp. 47–69 in *Whither Opportunity?: Rising Inequality, Schools, and Children's Life Chances*, edited by G. J. Duncan and R. J. Murnane. New York, NY: Russell Sage Foundation.

van Ewijk, Reyn and Peter Sleegers. 2010. "The Effect of Peer Socioeconomic Status on Student Achievement: A Meta-Analysis." *Educational Research Review* 5:134–50.

Figlio, David N. 2007. "Boys Named Sue: Disruptive Children and Their Peers." *Education Finance and Policy* 2(4):376–94.

Fryer, Roland G. and Steven D. Levitt. 2004. "Understanding the Black-White Test Score Gap in

the First Two Years of School." *The Review of Economics and Statistics* 86(2):447–64.

Goldhaber, Dan, Malcolm Wolff, and Timothy Daly. 2020. *Assessing the Accuracy of Elementary School Test Scores as Predictors of Students' High School Outcomes*. 235–0520. Washington, DC.

Goldsmith, Pat Rubio. 2011. "Coleman Revisited: School Segregation, Peers, and Frog Ponds." *American Educational Research Journal* 48(3):508–35.

Guryan, Jonathan. 2004. "Desegregation and Black Dropout Rates." *American Economic Review* 94(4):919–43.

Halpern-Manners, Andrew. 2016. "Measuring Students' School Context Exposures: A Trajectory-Based Approach." *Social Science Research* 58:135–49.

Hanushek, Eric A. and Steven G. Rivkin. 2006. *School Quality and the Black-White Achievement Gap*. Cambridge, MA: National Bureau of Economic Research.

von Hippel, Paul T. 2007. "Regression with Missing Ys: An Improved Strategy for Analyzing Multiply Imputed Data." *Sociological Methodology* 37(1):83–117.

Hussar, Bill, Jijun Zhang, Sarah Hein, Ke Wang, Ashley Roberts, Jiashan Cui, Mary Smith, Farrah Bullock Mann, Amy Barmer, and Rita Dilig. 2020. *The Condition of Education 2020*. Washington, DC.

Jencks, Christopher and Meredith Phillips. 1998. *The Black-White Test Score Gap*. Washington, DC: Brookings Institution Press.

Johnson, Rucker C. 2019. *Children of the Dream: Why School Integration Works*. New York: Basic Books.

Kao, Grace and Jennifer S. Thompson. 2003. "Racial and Ethnic Stratification in Educational Achievement and Attainment." *Annual Review of Sociology* 29:417–42.

Langenkamp, Amy G. and William Carbonaro. 2018. "How School Socioeconomic Status Affects Achievement Growth across School Transitions in Early Educational Careers." *Sociology of Education* 91(4):358–78.

Lauen, Douglas Lee and S. Michael Gaddis. 2013. "Exposure to Classroom Poverty and Test Score Achievement: Contextual Effects or Selection?" *American Journal of Sociology* 118(4):973–79.

Logan, John R. 2011. *Separate and Unequal: The Neighborhood Gap for Blacks, Hispanics, and Asians in Metropolitan America*. Providence, RI.

LoGerfo, Laura, Austin Nichols, and Sean F. Reardon. 2006. *Achievement Gains in Elementary and High Schools*. Washington, DC: Urban Institute.

Lubienski, Sarah Theule. 2002. "A Closer Look at Black-White Mathematics Gaps: Intersections of Race and SES in NAEP Achievement and Instructional Practices Data." *The Journal of Negro Education* 71(4):269–87.

Magnuson, Katherine A. and Greg J. Duncan. 2006. "The Role of Family Socioeconomic

Resources in the Black-White Test Score Gap among Young Children." *Developmental Review* 26(4):365–99.

Magnuson, Katherine and Jane Waldfogel, eds. 2008. *Steady Gains and Stalled Progress: Inequality and the Black-White Test Score Gap*. New York: Russell Sage Foundation.

Massey, Douglas S. and Stefanie Brodmann. 2014. *Spheres of Influence: The Social Ecology of Racial and Class Inequality*. New York, NY: Russell Sage Foundation.

McCall, Leslie. 2005. "The Complexity of Intersectionality." *Signs* 30:1771–1800.

McFarland, Joel, Bill Hussar, Xiaolei Wang, Jijun Zhang, Ke Wang, Amy Rathbun, Amy Barmer, Emily Forrest Cataldi, and Farrah Bullock Mann. 2018. *The Condition of Education 2018 (NCES 2018-144)*. Washington, DC.

Michelmore, Katherine and Susan M. Dynarski. 2017. "The Gap Within the Gap: Using Longitudinal Data to Understand Income Differences in Educational Outcomes." *AERA Open* 3(1).

Mickelson, Roslyn A. and Martha C. Bottia. 2009. "Integrated Education and Mathematics Outcomes: A Synthesis of Social Science Research." *North Carolina Law Review* 88:993–1090.

Murray, Brittany, Thurston Domina, Linda Renzulli, and Rebecca Boylan. 2019. "Civil Society Goes to School: Parent-Teacher Associations and the Equality of Educational Opportunity." *RSF: The Russell Sage Foundation Journal of the Social Sciences* 5(3):41–63.

National Center for Education Statistics. 2013. *Trends in Academic Progress 2012*. Washington, DC.

Owens, Ann. 2018. "Income Segregation between School Districts and Inequality in Students' Achievement." *Sociology of Education* 91(1):1–27.

Owens, Ann. 2020. "Unequal Opportunity: School and Neighborhood Segregation in the USA." *Race and Social Problems* 12(1):29–41.

Owens, Ann, Sean F. Reardon, and Christopher Jencks. 2016. "Income Segregation between Schools and School Districts." *American Educational Research Journal* 53(4):1159–97.

Paschall, Katherine W., Elizabeth T. Gershoff, and Megan Kuhfeld. 2018. "A Two Decade Examination of Historical Race/Ethnicity Disparities in Academic Achievement by Poverty Status." *Journal of Youth and Adolescence* 47(6):1164–77.

Pattillo, Mary. 2005. "Black Middle-Class Neighborhoods." *Annual Review of Sociology* 31:305–29.

Reardon, Sean F. 2011. "The Widening Academic Achievement Gap Between the Rich and the Poor: New Evidence and Possible Explanations." Pp. 91–117 in *Whither Opportunity? Rising Inequality, Schools, and Children's Life Chances*, edited by G. J. Duncan and R. J. Murnane. New York, NY: Russell Sage Foundation.

Reardon, Sean F. 2016. "School Segregation and Racial Academic Achievement Gaps." *RSF: The Russell Sage Foundation Journal of the Social Sciences* 2(5):34–57.

Reardon, Sean F., Lindsday Fox, and Joseph Townsend. 2015. "Neighborhood Income Composition by Household Race and Income, 1990–2009." *The ANNALS of the American Academy of Political and Social Science* 660(1):78–97.

Reardon, Sean F. and Claudia Galindo. 2009. "The Hispanic-White Achievement Gap in Math and Reading in Elementary Grades." *American Educational Research Journal* 46(3):853–91.

Reardon, Sean F., Elena Tej Grewal, Demetra Kalogrides, and Erica Greenberg. 2012. "Brown Fades: The End of Court-Ordered School Desegregation and the Resegregation of American Public Schools." *Journal of Policy Analysis and Management* 31(4):876–904.

Reardon, Sean F., Demetra Kalogrides, and Kenneth Shores. 2019. "The Geography of Racial/Ethnic Test Score Gaps." *American Journal of Sociology* 124(4):1164–1221.

Reardon, Sean F. and Ann Owens. 2014. "60 Years after Brown: Trends and Consequences of School Segregation." *Annual Review of Sociology* 40:199–218.

Reardon, Sean F. and Lori Rhodes. 2011. "The Effects of Socioeconomic School Integration Plans on Racial School Desegregation." Pp. 187–208 in *Integrating Schools in a Changing Society: New Policies and Legal Options for a Multiracial Generation.*, edited by E. Frankenberg and E. DeBray-Pelot. Chapel Hill, NC: University of North Carolina Press.

Reardon, Sean F., Joseph P. Robinson-Cimpian, and Ericka S. Weathers. 2014. "Patterns and Trends in Racial/Ethnic and Socioeconomic Academic Achievement Gaps." *Handbook of Research in Education Finance and Policy, Second Edition* (April):491–509.

Reber, Sarah J. 2010. "School Desegregation and Educational Attainment for Blacks." *Journal of Human Resources* 45(4):893–914.

Roscigno, Vincent J. 2000. "Family/School Inequality and African-American/Hispanic Achievement." *Social Problems* 47(2):266–90.

Rothstein, Jesse and Nathan Wozny. 2013. "Permanent Income and the Black-White Test Score Gap." *The Journal of Human Resources* 48(3):510–44.

Rumberger, Russell W. and Gregory J. Palardy. 2005. "Test Scores, Dropout Rates, and Transfer Rates as Alternative Indicators of High School Performance." *American Educational Research Journal* 42(1):3–42.

Ryabov, Igor and Jennifer Van Hook. 2007. "School Segregation and Academic Achievement among Hispanic Children." *Social Science Research* 36(2):767–88.

Saatcioglu, Argun. 2010. "Disentangling School- and Student-Level Effects of Desegregation and Resegregation on the Dropout Problem in Urban High Schools: Evidence From the Cleveland Municipal School District, 1977-1998." *Teachers College Record* 112(5):1391–1442.

Schudde, Lauren. 2018. "Heterogeneous Effects in Education: The Promise and Challenge of Incorporating Intersectionality Into Quantitative Methodological Approaches." *Review of Research in Education* 42(1):72–92.

Schwartz, Heather. 2012. “Housing Policy Is School Policy: Economically Integrative Housing Promotes Academic Success in Montgomery County, Maryland.” Pp. 27–65 in *The Future of School Integration*, edited by R. D. Kahlenberg. New York, NY: The Century Foundation.

Sharkey, Patrick. 2014. “Spatial Segmentation and the Black Middle Class.” *American Journal of Sociology* 119(4):903–54.

Skiba, Russell J., Robert S. Michael, Abra Carroll Nardo, and Reece L. Peterson. 2002. “The Color of Discipline: Sources of Racial and Gender Disproportionality in School Punishment.” *The Urban Review* 34(4):317–42.

Tefera, Adai A., Jeanne M. Powers, and Gustavo E. Fischman. 2018. “Intersectionality in Education: A Conceptual Aspiration and Research Imperative.” *Review of Research in Education* 42(1):vii–xvii.

U.S. Government Accountability Office. 2016. *Better Use of Information Could Help Agencies Identify Disparities and Address Racial Discrimination*. Washington, DC.

Yeung, Wei Jun Jean and Kathryn M. Pfeiffer. 2009. “The Black-White Test Score Gap and Early Home Environment.” *Social Science Research* 38(2):412–37.

Table 1. Descriptive Statistics for Math Achievement, SES, School Composition, and Control Variables by Student Race/Ethnicity

	White	Black	Hispanic	Asian
Dependent Variables				
Mean Math Score, 2014-15	2466.676	2401.236	2411.859	2495.984
	(78.734)	(78.020)	(73.510)	(80.185)
Mean Annual Growth Rate	30.596	21.493	24.062	36.860
	(72.101)	(72.138)	(72.134)	(72.162)
Socioeconomic Disadvantage				
Mean Cumulative SED Rate	.295	.734	.819	.355
	(.399)	(.365)	(.317)	(.424)
Never SED	.572	.141	.088	.517
1-49% SED	.124	.079	.056	.112
50-99% SED	.148	.291	.234	.168
Always SED	.156	.489	.622	.204
Parent Education				
Less than High School	.081	.209	.492	.106
High School Graduate	.218	.330	.271	.174
Some College	.260	.309	.163	.223
BA or More	.441	.153	.074	.497
SED x Parent Education				
Mean Cumulative SED Rate, <HS	.742	.914	.943	.800
Mean Cumulative SED Rate, HS	.525	.838	.823	.654
Mean Cumulative SED Rate, Some College	.318	.693	.660	.409
Mean Cumulative SED Rate, BA+	.084	.344	.336	.130
School SES Composition				
Mean Cumulative SED Rate	.409	.698	.759	.428
	(.264)	(.251)	(.228)	(.300)
Mean Parent BA Rate	.366	.169	.126	.389
	(.236)	(.107)	(.120)	(.179)
Controls				
Gender = Female	.482	.488	.490	.488
3rd Grade Cohort	.506	.513	.512	.501
Sample Size				
Proportion of Student-Grade Observations	.244	.059	.577	.120
N Students	252,109	62,015	561,542	121,816

Notes: Descriptive statistics reflect imputed values for parent education (23% of values were missing).

Table 2. Proportion of Racial/Ethnic Achievement Inequalities Accounted for by Student SES

Model	Grade	Asian-White	Black-White	Hispanic-White
			Scale Score Gap	
No SES Controls	3	27.84	-64.34	-52.96
	4	30.86	-67.42	-56.51
	5	35.02	-79.19	-63.89
	6	45.31	-89.93	-70.49
	7	51.65	-96.95	-78.44
			Percent Difference in Gap	
Parent Ed	3	-4.96%	-29.89%	-54.03%
	4	-1.74%	-31.26%	-55.24%
	5	1.99%	-31.17%	-57.16%
	6	4.32%	-30.65%	-59.75%
	7	7.70%	-32.25%	-61.37%
SED	3	12.17%	-46.28%	-62.72%
	4	12.77%	-46.90%	-62.89%
	5	16.42%	-45.71%	-63.93%
	6	16.36%	-45.50%	-65.98%
	7	16.83%	-45.14%	-63.67%
Parent Ed + SED	3	6.69%	-48.39%	-74.89%
	4	8.71%	-49.56%	-75.68%
	5	13.37%	-48.80%	-77.69%
	6	14.72%	-48.18%	-80.74%
	7	16.63%	-48.80%	-80.21%

Notes: Lower three panels present the percent difference in the scale score gap (top panel) in models controlling for parent education, SED, and both parent education and SED, respectively.

Table 3. Proportion of Within-SES Racial/Ethnic Achievement Inequalities Accounted for by School SES Composition (Average across Grades)

	Asian-White	Black-White	Hispanic-White
SED Category	*Scale Score Gap*		
Never SED	43.01	-41.90	-28.59
1-49% SED	39.99	-40.56	-25.23
50-99% SED	41.54	-47.52	-26.16
Always SED	46.37	-42.23	-18.45
	Percent Difference in Gap		
Controlling for School Mean Cumulative SED Rate			
Never SED	-32.28%	-19.05%	-38.38%
1-49% SED	-2.99%	-14.00%	-31.99%
50-99% SED	7.33%	-21.96%	-37.93%
Always SED	7.82%	-21.03%	-23.81%
Parent Education Category	*Scale Score Gap*		
< High School	48.46	-52.22	-15.90
High School Graduate	39.46	-59.28	-26.70
Some College	31.90	-59.47	-31.83
BA+	34.32	-58.04	-37.39
	Percent Difference in Gap		
Controlling for School Mean BA Rate			
< High School	-2.36%	-24.03%	-37.73%
High School Graduate	0.40%	-26.84%	-44.20%
Some College	-7.69%	-24.25%	-35.96%
BA+	-40.44%	-14.74%	-23.38%

Notes: The top panel presents within-SED group racial/ethnic achievement differences, and the second panel presents the percent difference in within-SED achievement differences controlling for school mean cumulative SED rate. The bottom two panels present parallel analyses for parent education group and models controlling for school mean BA rate.

Figure 1. Racial/Ethnic Math Score Trajectories within SES Categories

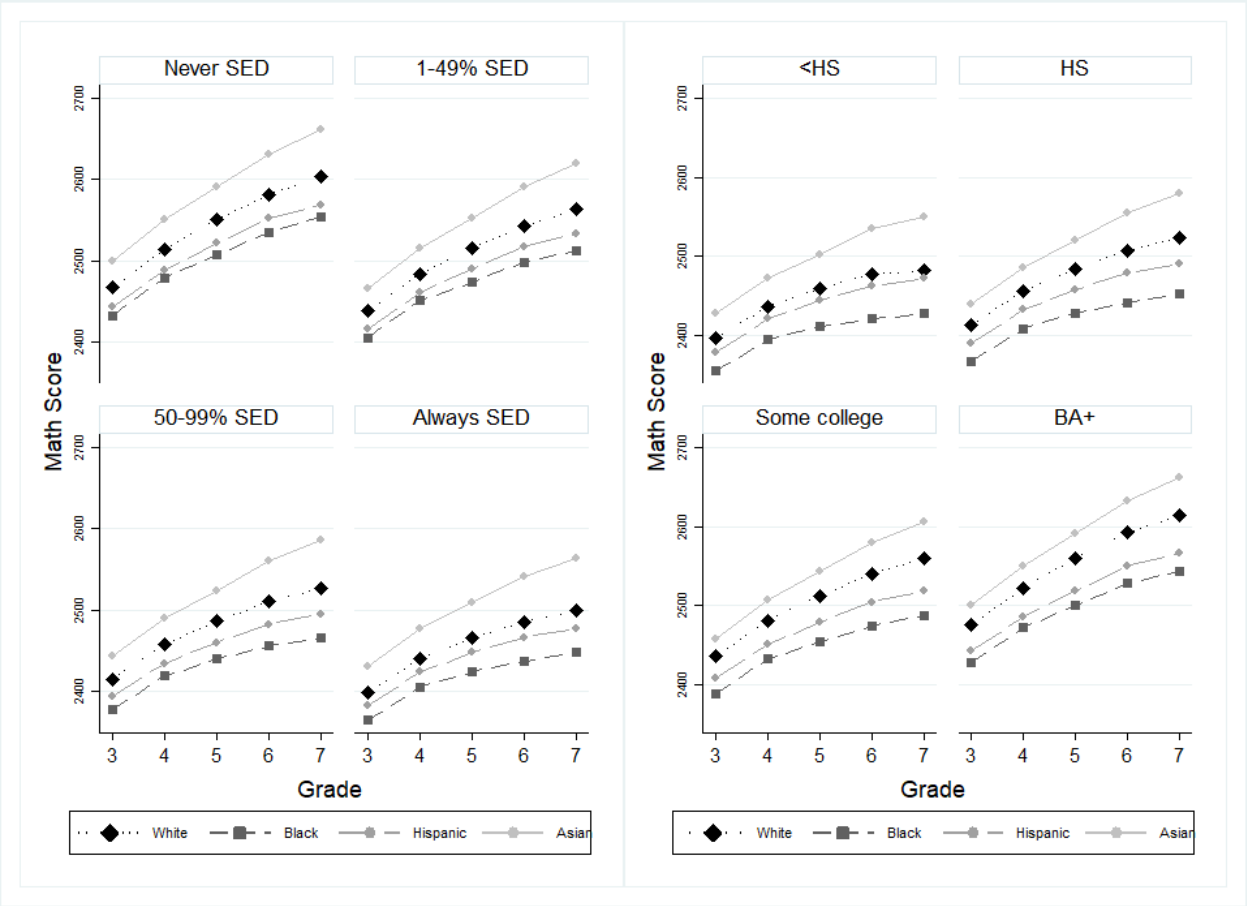


Figure 2a. Mean SED Composition of School by Student Race/Ethnicity, 2018

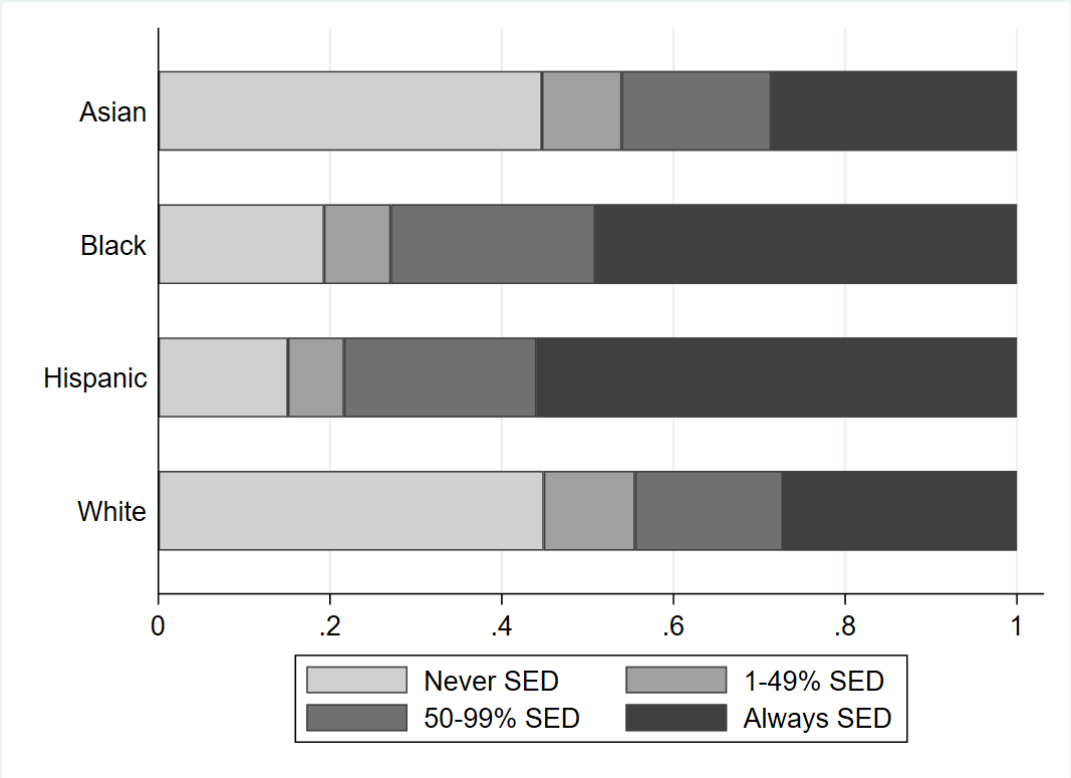


Figure 2b. Mean Parent Education Composition of School by Student Race/Ethnicity, 2018

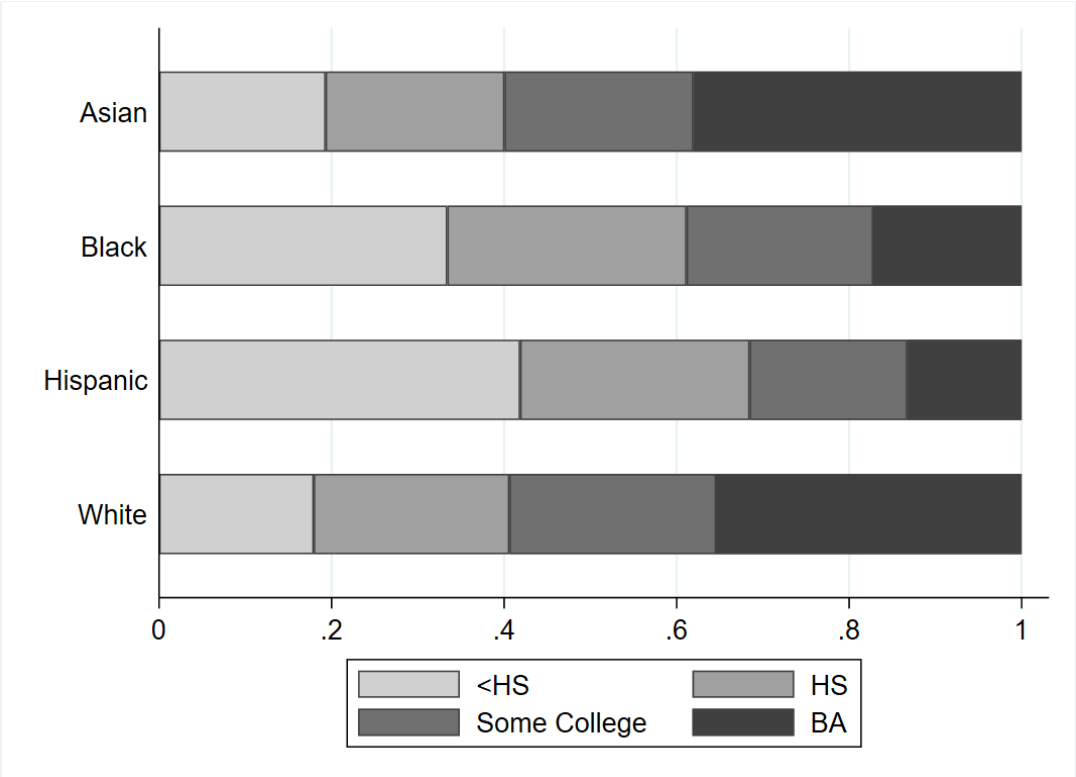


Figure 3a. Mean SED Composition of School by Race/Ethnicity by SED Category, 2018

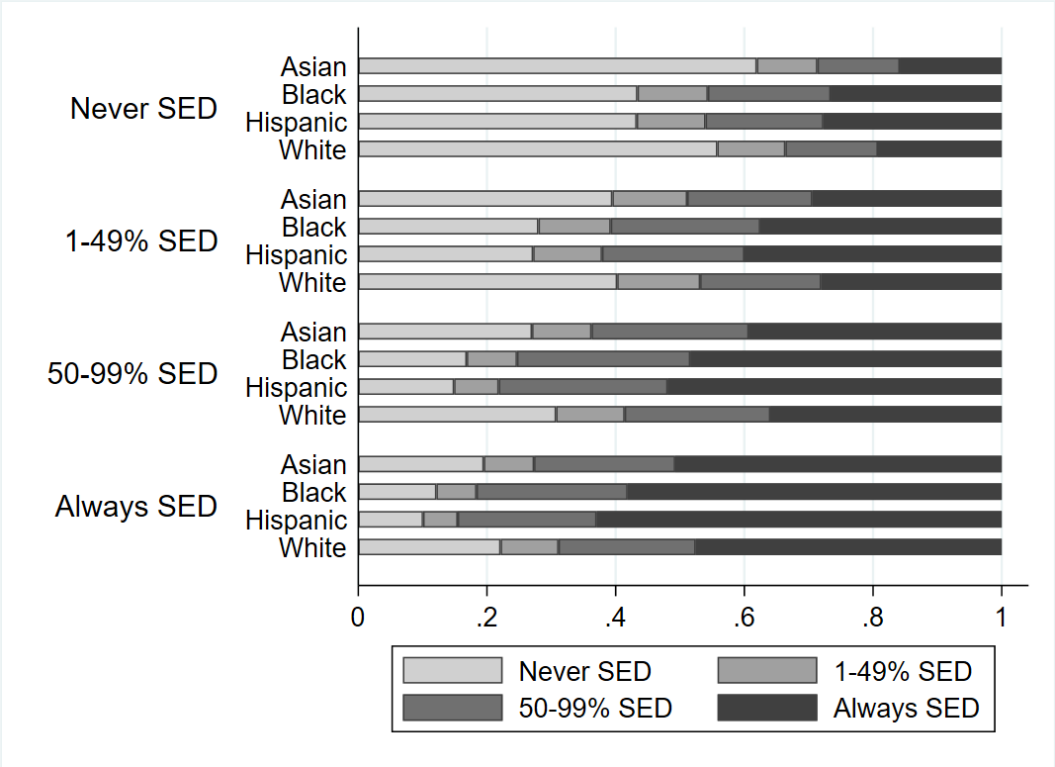


Figure 3b. Mean Parent Education Composition of School by Race/Ethnicity by Parent Education, 2018

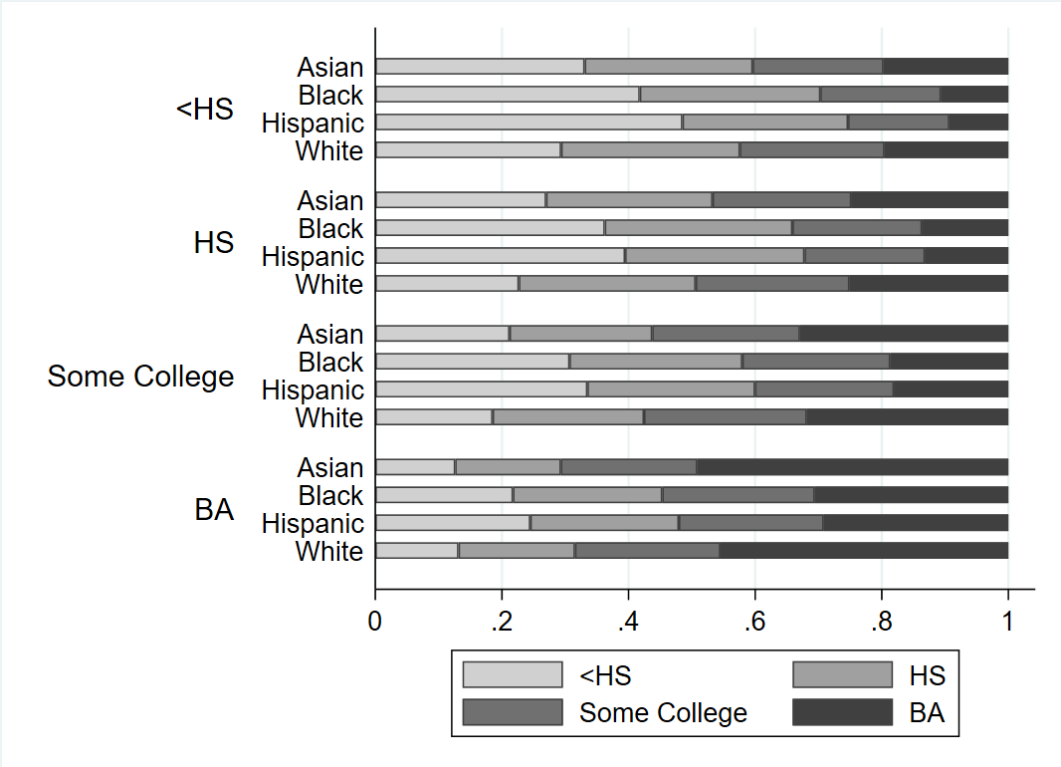


Figure 4. Racial/Ethnic Inequalities in Math Scores within SED Categories, Controlling for School SED Composition

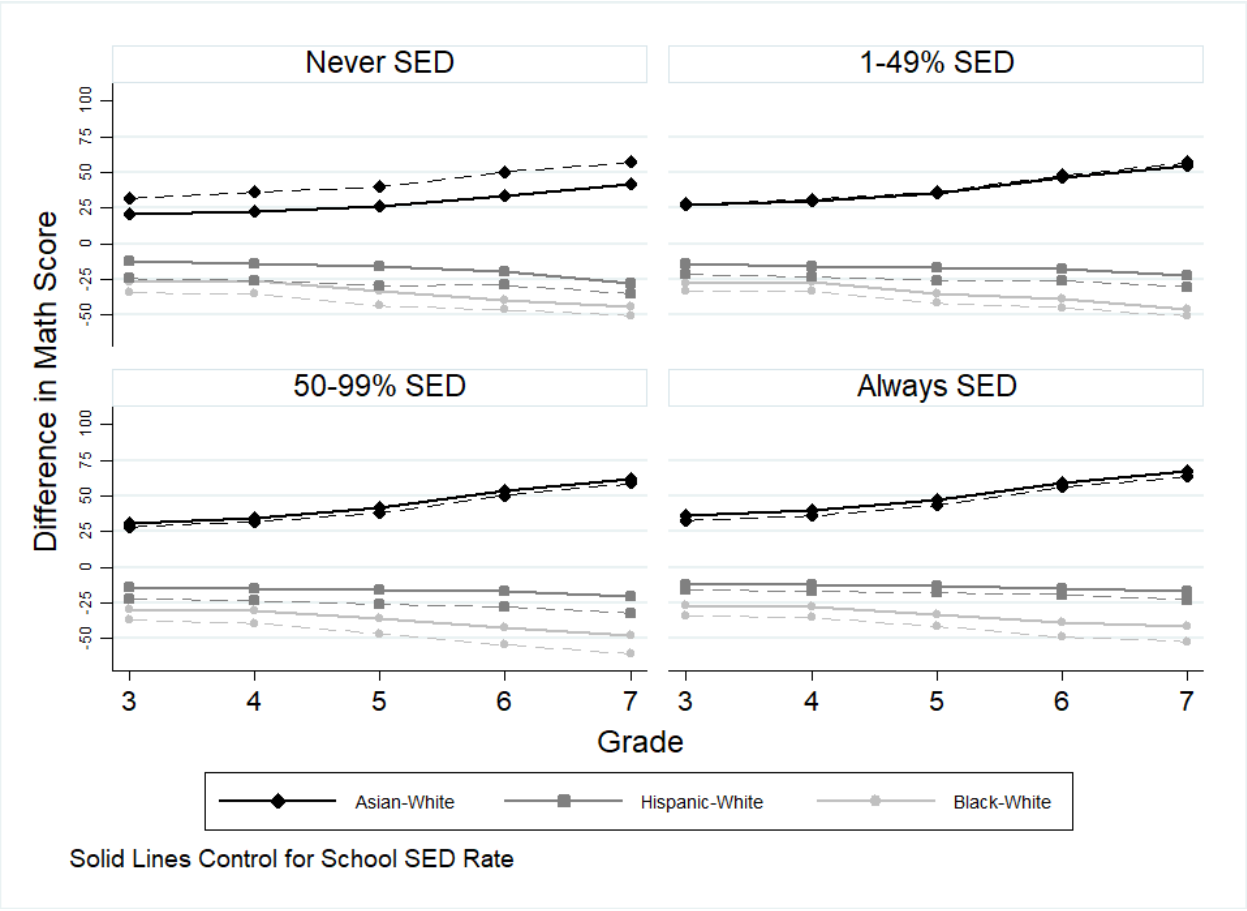
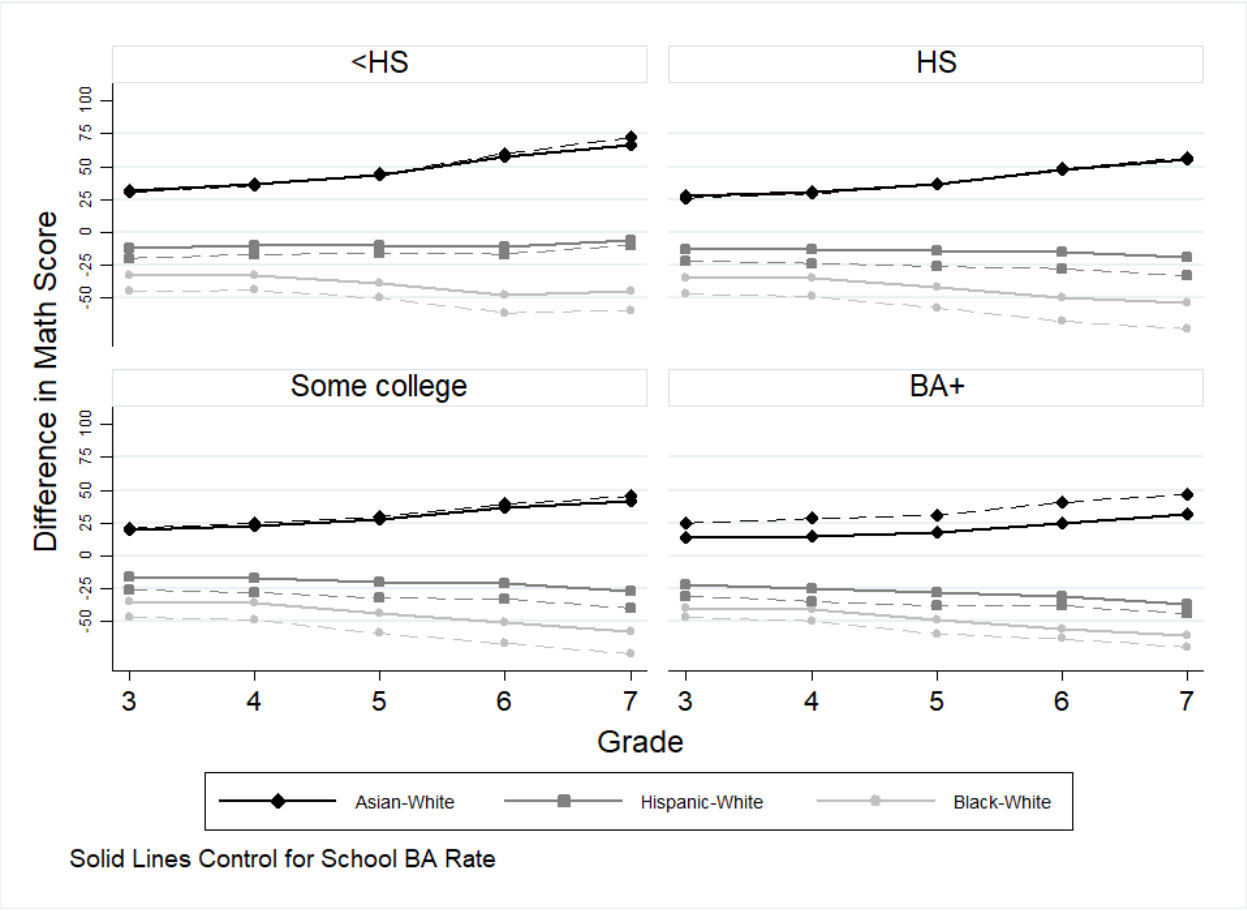
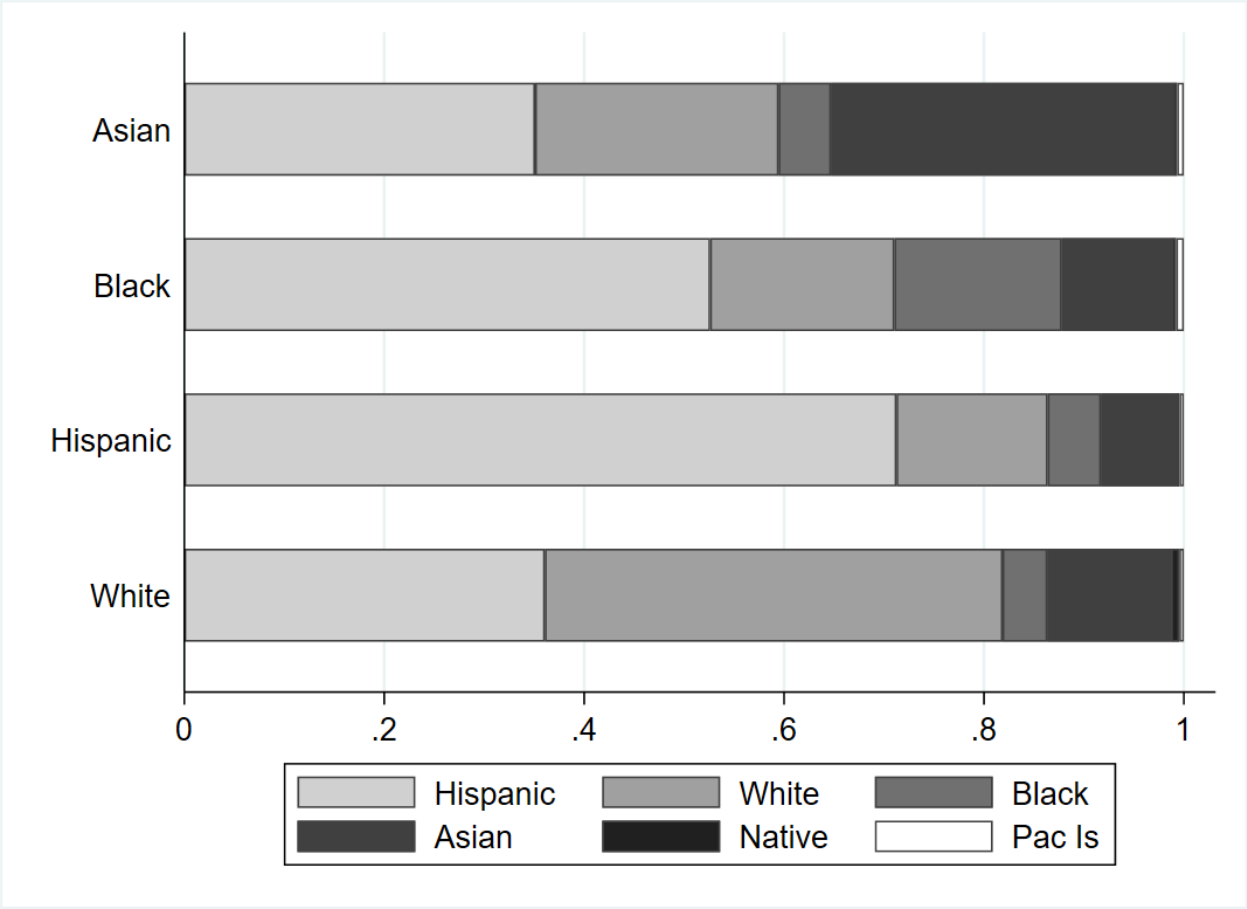


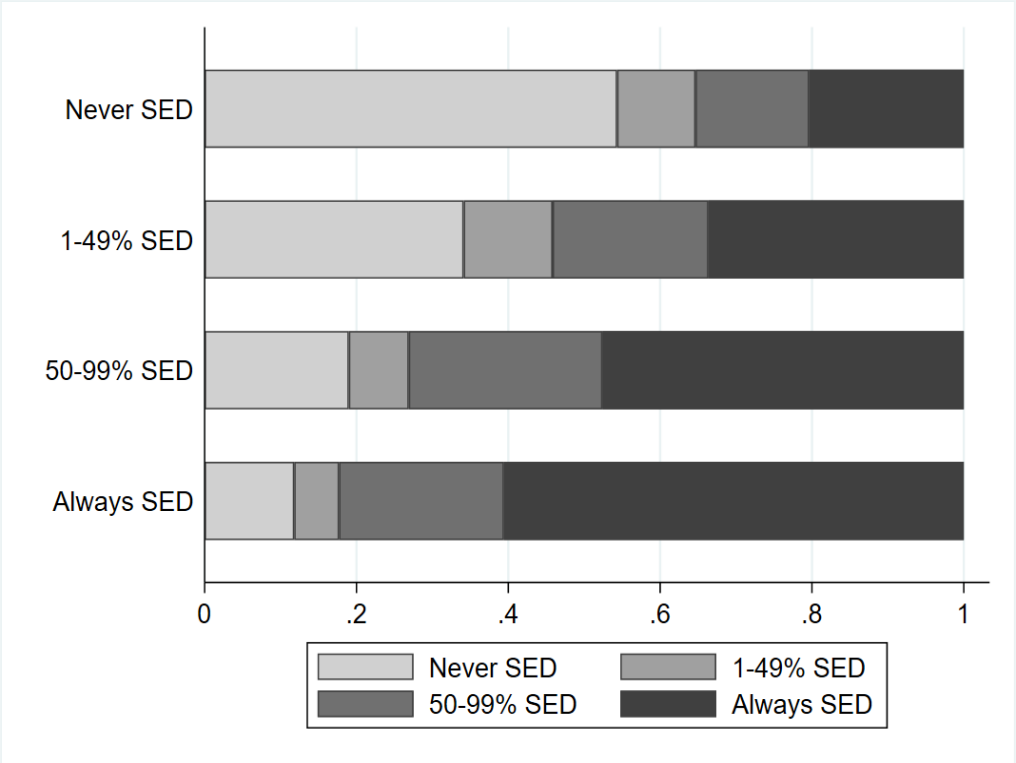
Figure 5. Racial/Ethnic Inequalities in Math Scores within Parent Education Categories, Controlling for School Parent BA Rate



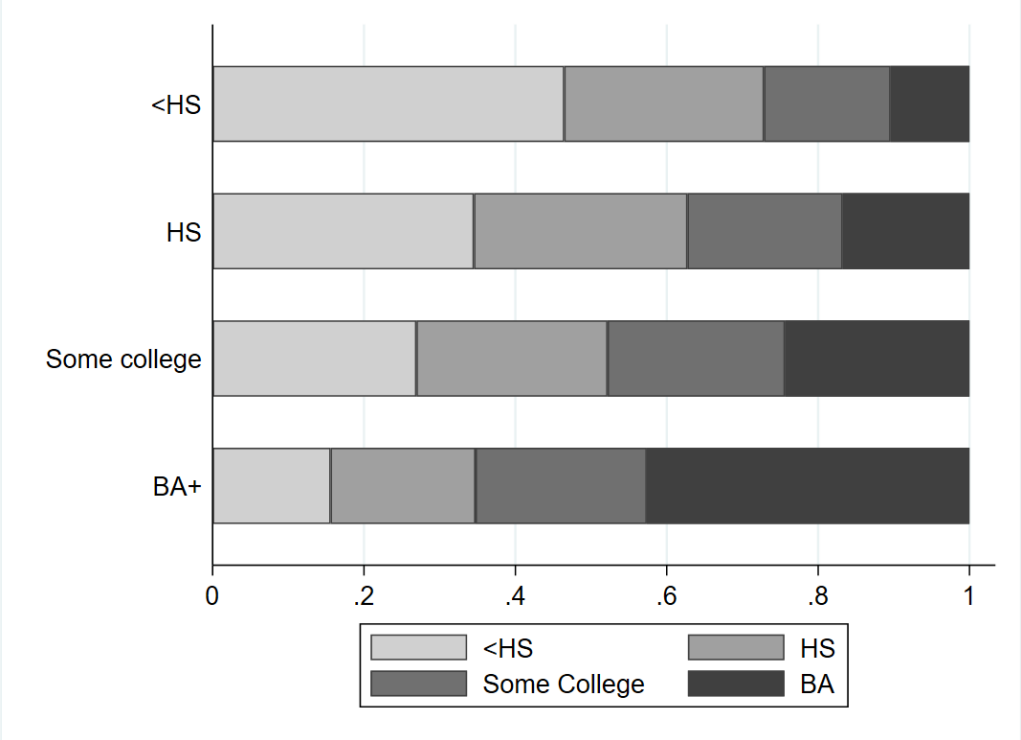
Appendix Figure 1. Mean Racial/Ethnic Composition of School by Student Race/Ethnicity, 2018



Appendix Figure 2a. Mean SED Composition of Schools by SED Category, 2018



Appendix Figure 2b. Mean Parent Education Composition of Schools by Parent Education Category, 2018



Appendix Table 1. Mean School SES Composition by Student Race/Ethnicity, 2015-2018

	Year	<HS	HS	Some College	BA+	Never SED	1-49% SED	50-99% SED	Always SED
Hispanic	2015	42.8%	26.9%	18.1%	12.2%	13.6%	6.4%	23.1%	56.9%
	2016	42.9%	26.9%	18.0%	12.2%	13.7%	6.4%	23.0%	56.9%
	2017	42.5%	26.7%	18.1%	12.6%	14.2%	6.5%	22.8%	56.6%
	2018	41.9%	26.6%	18.3%	13.3%	15.1%	6.5%	22.4%	56.0%
White	2015	16.2%	22.5%	24.5%	36.9%	47.2%	11.3%	16.9%	24.5%
	2016	16.2%	22.4%	24.4%	37.1%	47.1%	11.3%	16.9%	24.7%
	2017	16.8%	22.5%	24.2%	36.4%	46.3%	11.0%	17.2%	25.5%
	2018	17.9%	22.7%	24.0%	35.4%	44.9%	10.6%	17.2%	27.3%
Black	2015	33.0%	28.3%	22.2%	16.5%	18.2%	8.0%	25.2%	48.7%
	2016	32.9%	28.2%	22.2%	16.7%	18.3%	8.1%	25.0%	48.6%
	2017	33.1%	28.0%	22.0%	16.9%	18.7%	7.9%	24.5%	48.8%
	2018	33.4%	27.7%	21.6%	17.2%	19.3%	7.8%	23.8%	49.1%
Asian	2015	18.2%	20.6%	22.2%	39.1%	46.2%	9.8%	17.4%	26.7%
	2016	18.2%	20.5%	22.1%	39.2%	46.1%	9.7%	17.3%	26.8%
	2017	18.6%	20.6%	22.0%	38.8%	45.5%	9.6%	17.5%	27.4%
	2018	19.3%	20.7%	21.9%	38.1%	44.7%	9.3%	17.4%	28.6%

Appendix Table 2. Mean School SED Composition by Student Race/Ethnicity and SED Category, 2015-2018

	Year	Hispanic				White				Black				Asian			
		Never SED	1-49%	50-99%	Always SED	Never SED	1-49%	50-99%	Always SED	Never SED	1-49%	50-99%	Always SED	Never SED	1-49%	50-99%	Always SED
Never SED	2015	45.9%	11.4%	18.0%	24.7%	60.0%	11.2%	13.4%	15.4%	46.6%	11.9%	18.7%	22.8%	65.4%	9.8%	12.0%	12.8%
	2016	45.7%	11.4%	18.0%	24.9%	59.7%	11.2%	13.4%	15.6%	46.1%	11.8%	18.8%	23.4%	65.3%	9.8%	12.0%	12.9%
	2017	44.9%	11.1%	18.2%	25.7%	58.3%	10.9%	13.9%	16.8%	45.2%	11.4%	18.9%	24.5%	64.2%	9.6%	12.4%	13.8%
	2018	43.3%	10.7%	18.3%	27.7%	55.8%	10.6%	14.4%	19.2%	43.4%	10.9%	19.1%	26.6%	61.9%	9.4%	12.8%	15.8%
1-49% SED	2015	27.1%	11.5%	22.9%	38.5%	42.2%	14.3%	18.8%	24.8%	28.5%	12.4%	24.5%	34.6%	39.7%	13.0%	19.7%	27.6%
	2016	27.2%	11.5%	22.8%	38.5%	42.1%	14.2%	18.7%	25.0%	28.2%	12.3%	24.4%	35.1%	39.9%	12.8%	19.6%	27.6%
	2017	27.1%	11.4%	22.6%	38.9%	41.1%	13.9%	18.9%	26.1%	28.4%	12.0%	23.9%	35.7%	39.6%	12.4%	19.7%	28.2%
	2018	27.2%	10.7%	22.1%	40.0%	40.2%	12.9%	18.8%	28.1%	28.0%	11.2%	23.2%	37.5%	39.5%	11.6%	19.4%	29.5%
50-99% SED	2015	13.0%	7.0%	27.4%	52.6%	30.4%	11.3%	23.5%	34.8%	15.0%	8.1%	28.7%	48.2%	25.2%	9.6%	25.6%	39.7%
	2016	13.2%	7.0%	27.2%	52.7%	30.6%	11.3%	23.2%	34.9%	15.2%	8.1%	28.3%	48.3%	25.4%	9.6%	25.3%	39.7%
	2017	13.9%	7.0%	27.3%	51.8%	30.7%	11.1%	23.2%	35.0%	16.0%	8.0%	28.0%	48.0%	26.0%	9.5%	25.1%	39.4%
	2018	14.9%	6.9%	26.3%	51.9%	30.7%	10.7%	22.6%	36.0%	16.9%	7.8%	26.9%	48.4%	27.0%	9.3%	24.4%	39.3%
Always SED	2015	8.0%	5.1%	22.2%	64.7%	20.6%	9.1%	22.2%	48.0%	10.4%	6.2%	25.0%	58.4%	17.2%	7.8%	23.1%	51.8%
	2016	8.1%	5.1%	22.2%	64.6%	20.8%	9.2%	22.2%	47.9%	10.6%	6.3%	24.9%	58.2%	17.4%	7.9%	23.1%	51.6%
	2017	8.8%	5.2%	21.7%	64.3%	21.1%	9.1%	21.9%	48.0%	11.1%	6.2%	24.1%	58.5%	18.1%	7.9%	22.7%	51.3%
	2018	10.1%	5.4%	21.6%	63.0%	22.1%	9.0%	21.3%	47.6%	12.1%	6.2%	23.5%	58.1%	19.5%	7.8%	21.9%	50.7%

Notes: Row 1 shows that in 2015, the average Hispanic Never SED student attended a school where 45.9% of peers were never SED, 11.4% were SED 1-49% of school years, 18.0% were SED 50-99% of school years, and 24.7% were always SED. The next sets of columns show school composition for White students, then Black students, then Asian students by their SED category as indexed in column 1.

Appendix Table 3. Mean School Parent Education Composition by Race/Ethnicity and Parent Education Category, 2015-2018

	Year	Hispanic				White				Black				Asian			
		<HS	HS	Some College	BA+	<HS	HS	Some College	BA+	<HS	HS	Some College	BA+	<HS	HS	Some College	BA+
<HS	2015	50.1%	26.5%	15.5%	7.9%	28.6%	29.2%	23.1%	19.1%	41.8%	29.4%	19.2%	9.6%	33.3%	27.6%	20.8%	18.3%
	2016	50.1%	26.5%	15.4%	8.0%	28.7%	29.0%	23.1%	19.2%	41.8%	29.3%	19.2%	9.8%	33.2%	27.5%	20.8%	18.5%
	2017	49.8%	26.1%	15.6%	8.4%	29.2%	28.5%	23.1%	19.2%	42.5%	28.4%	19.1%	10.0%	33.3%	27.1%	20.8%	18.9%
	2018	48.5%	26.2%	16.0%	9.3%	29.4%	28.2%	22.9%	19.6%	41.8%	28.5%	19.1%	10.6%	33.1%	26.5%	20.7%	19.7%
HS	2015	40.5%	28.7%	18.9%	11.9%	21.7%	28.2%	24.9%	25.1%	36.2%	30.1%	21.1%	12.6%	27.1%	26.7%	22.3%	23.9%
	2016	40.5%	28.6%	18.9%	12.0%	21.8%	28.1%	24.8%	25.3%	36.2%	30.0%	21.1%	12.7%	27.1%	26.7%	22.3%	24.0%
	2017	39.8%	28.8%	18.9%	12.5%	22.0%	28.2%	24.6%	25.2%	35.9%	30.3%	20.7%	13.1%	26.9%	26.7%	22.1%	24.3%
	2018	39.5%	28.3%	19.0%	13.2%	22.7%	27.9%	24.3%	25.1%	36.2%	29.6%	20.5%	13.7%	27.0%	26.3%	21.9%	24.8%
Some College	2015	33.6%	27.0%	22.1%	17.3%	16.8%	23.9%	26.5%	32.8%	29.8%	27.9%	24.2%	18.1%	20.2%	22.8%	23.9%	33.1%
	2016	33.6%	26.9%	22.1%	17.4%	16.9%	23.9%	26.3%	32.9%	29.7%	27.8%	24.2%	18.3%	20.2%	22.7%	23.9%	33.2%
	2017	33.5%	26.6%	22.2%	17.6%	17.5%	23.8%	26.2%	32.5%	30.1%	27.5%	23.9%	18.4%	20.6%	22.6%	23.8%	33.1%
	2018	33.5%	26.5%	21.9%	18.1%	18.5%	23.9%	25.7%	31.8%	30.7%	27.3%	23.4%	18.7%	21.2%	22.5%	23.3%	32.9%
BA+	2015	23.8%	23.3%	23.1%	29.9%	10.7%	17.4%	23.3%	48.7%	19.9%	23.4%	25.0%	31.8%	11.0%	16.0%	21.6%	51.4%
	2016	23.8%	23.2%	23.1%	29.9%	10.8%	17.3%	23.2%	48.7%	19.9%	23.4%	24.9%	31.9%	11.0%	15.9%	21.6%	51.5%
	2017	23.9%	23.3%	23.0%	29.8%	11.6%	17.8%	23.1%	47.5%	20.4%	23.4%	24.5%	31.7%	11.5%	16.2%	21.5%	50.8%
	2018	24.5%	23.5%	22.9%	29.2%	13.1%	18.4%	23.0%	45.5%	21.7%	23.6%	24.1%	30.6%	12.6%	16.7%	21.6%	49.1%

Notes: Row 1 shows that in 2015, the average Hispanic child of non-high school graduate parents attended a school where 50.1% of peers' parents were non-high school graduates, 26.5% of peers' parents were high school graduates, 15.5% of peers' parents had some college education, and 7.9% of peers' parents had at least a BA. The next sets of columns show school composition for White students, then Black students, then Asian students by their parent education category as indexed in column 1.