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Is Separate Still Unequal? New Evidence on School Segregation

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ABSTRACT

U.S. public schools are racially and economically segregated. Prior research shows that the desegregation of Southern schools beginning in the 1960s led to significant benefits for Black students. Less clear, however, is whether segregation today has the same harmful effects as it did 50 years ago, nor do we have clear evidence about the mechanisms through which segregation affects achievement. We estimate the effects of current-day school segregation on racial achievement gaps using 11 years of data from all U.S. public districts. We find that racial segregation is strongly associated with the magnitude of achievement gaps in third grade and the rate at which gaps grow from third to eighth grade. The association of racial segregation with achievement gap growth is completely accounted for by racial differences in school poverty (termed "racial economic segregation"). Thus, racial segregation is harmful because it concentrates minority students in high-poverty schools, which are, on average, less effective than lower-poverty schools. Exploratory analyses show that segregation-related between-school differences in teacher characteristics are associated with unequal learning rates and account for roughly 20% of the effect of Black-White racial economic segregation. Further research is needed to explore mechanisms linking school segregation to achievement gap growth.

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ABSTRACT

U.S. public schools are racially and economically segregated. Prior research shows that the desegregation of Southern schools beginning in the 1960s led to significant benefits for Black students. Less clear, however, is whether segregation today has the same harmful effects as it did 50 years ago, nor do we have clear evidence about the mechanisms through which segregation affects achievement. We estimate the effects of current-day school segregation on racial achievement gaps using 11 years of data from all U.S. public districts. We find that racial segregation is strongly associated with the magnitude of achievement gaps in third grade and the rate at which gaps grow from third to eighth grade. The association of racial segregation with achievement gap growth is completely accounted for by racial differences in school poverty (termed "racial economic segregation"). Thus, racial segregation is harmful because it concentrates minority students in high-poverty schools, which are, on average, less effective than lower-poverty schools. Exploratory analyses show that segregation-related between-school differences in teacher characteristics are associated with unequal learning rates and account for roughly 20% of the effect of Black-White racial economic segregation. Further research is needed to explore mechanisms linking school segregation to achievement gap growth.

INTRODUCTION

In 1954, the Supreme Court ruled that state-mandated racial segregation in schools was unconstitutional. Fifteen years later—now more than fifty years ago—the desegregation of Southern school districts began in earnest. Those efforts were predicated on the belief that racial school segregation *per se* contributed to educational inequality in America. And indeed, following the school desegregation of the late 1960s and 1970s, racial achievement gaps declined substantially in the 1970s and 1980s (Reardon, Robinson-Cimpian, and Weathers 2015), suggesting that desegregation could indeed reduce racial inequality in educational outcomes. The desegregation of Southern school districts during this time had a positive impact on Black students' educational outcomes and no negative impact on those of White students' (Anstreicher, Fletcher, and Thompson 2022; Ashenfelter, Collins, and Yoon 2006; Guryan 2004; Johnson 2019).

While educationally beneficial, the desegregation efforts of the late 1960s and early 1970s did not last. Public schools today remain highly segregated both by race and class and there is little broad or sustained national policy interest in creating more integrated schools. Current efforts to integrate schools are largely decentralized. The one recent piece of proposed federal legislation to support desegregation—the Strength in Diversity Act of 2019—characterizes integration as a voluntary goal driven by local community preferences rather than as a necessary step to improve children's educational outcomes. In other words, it appears the country has retreated from the belief that segregation itself is harmful and quietly endorsed the belief that it is possible to have equally high-quality schools in every neighborhood, even if that means school systems remain racially and economically segregated.

This position assumes that school segregation today differs from the historical *de jure* segregation of the South in a way that makes it less harmful to students. There are several reasons one might think this is true. It may be that legally mandated segregation inflicted psychological harm that limited Black students' educational success in a way that current *de facto* segregation does not. *De jure* segregation

also came with stark differences in school resources for White and Black students; indeed, the sharp decline in funding inequality resulting from Southern desegregation appears to be a key reason why desegregation was beneficial for Black students (Johnson 2019). In recent decades funding disparities between districts in many states have further declined as a result of court-ordered or legislative school finance reforms that increased funding in low-income school districts (Lafortune, Rothstein, and Schanzenbach 2018). Given both the shift from *de jure* to *de facto* segregation and the decrease in school resource inequalities, does school segregation today still generate unequal educational opportunities and outcomes?

Our goal is to provide evidence to help answer this question. Using standardized test scores and segregation data from grades 3-8 in the 2008-09 through 2018-19 school years from nearly all public schools in the U.S., we examine the association between school segregation patterns and the growth of achievement gaps during the schooling years between White and Black students and between White and Hispanic students within school districts in the U.S.[1] Importantly, we seek to identify the effect of school segregation, net of residential segregation, on achievement gaps both by controlling for residential segregation patterns and by focusing on the growth of achievement gaps during schooling years, net of the initial size of the gap. We leverage variation in school segregation both between and within places, across grades and years, to identify the nature and magnitude of the association between segregation and the rate at which the achievement gaps change as children progress through school. Finally, we explore the mechanisms through which school segregation may operate by testing whether and how differences in school and teacher characteristics account for the association between school segregation and racial achievement gap growth.

We study two dimensions of school segregation. The first is racial segregation *per se*: differences

[1] While "Hispanic" is officially considered an ethnicity by the U.S. government (Office of Management and Budget, 1997), we use the term "race" to reference the categories of Black, Hispanic, and White throughout the paper in the interest of brevity.

in the *racial* composition of White, Black, and Hispanic children's schools. Racial segregation was the focus of the court-ordered desegregation efforts of the 1950s, 1960s, and 1970s; it reflects the common understanding of the term "segregation" today. However, racial segregation is often accompanied by a second form of segregation, which we refer to as "racial economic segregation." Racial economic segregation refers to differences in the *economic* composition of White, Black, and Hispanic children's schools. Due to the large and persistent link between race and poverty in the U.S. (Akee, Jones, and Porter 2019; Orfield, Kucsera, and Siegel-Hawley 2012), the two dimensions of segregation are highly correlated but conceptually distinct. Without some racial segregation, there can be no racial economic segregation. If White and Black students are evenly distributed among schools, then the average economic composition of White students' schools will necessarily be identical to that of Black students' schools. However, it is possible to have high levels of racial segregation but low racial economic segregation. This will be the case, for example, if Black and White students attend different schools, but all schools have equal economic composition.

Analyzing both racial segregation *per se* and racial economic segregation allows us to more clearly disentangle whether racial segregation may have consequences for educational achievement because of factors related to school racial composition or because of factors related to school economic composition. In this paper, we use the term "segregation" generally and the terms "racial segregation" and "racial economic segregation" to refer specifically to these two dimensions of school segregation. When necessary, we explicitly distinguish between segregation that occurs among schools and segregation that occurs among neighborhoods.

In addition to examining two dimensions of segregation, our work builds on the prior research on school segregation in several ways. First, we focus on how school segregation affects the *rate* at which achievement gaps grow as children progress through school. School factors, such as segregation, cannot affect the size of academic disparities that are present when children enter school (those are determined

by early childhood disparities in developmental and educational opportunities), so a focus on the change in achievement gaps during school provides a sharper test of whether school segregation affects achievement gaps than a focus on the size of achievement gaps. Second, unlike most research on school segregation and achievement patterns, which often focuses exclusively on White-Black disparities, we also investigate White-Hispanic segregation and its association with the growth of White-Hispanic achievement gaps. Thus, we can investigate whether segregation operates similarly for Black and Hispanic students. Third, we explore the mechanisms through which school segregation shapes the growth of achievement gaps. Specifically, we explore whether differences in school quality account for the associations between our measures of segregation and the growth of achievement gaps. And fourth, our analyses are based on more comprehensive and detailed data than available in prior studies. We use 11 years of data on school segregation and achievement patterns, which reflect the experiences and test scores of more than 50 million students in over 10,000 public school districts in the U.S. We focus on within-district segregation because districts have the most direct leverage to influence school segregation patterns. Given the unprecedented scale of our data, our analysis provides the most comprehensive evidence to date regarding the relationship between school segregation and the size and growth of academic achievement gaps.

SEGREGATION AND EDUCATIONAL OPPORTUNITY

We start from the understanding that racial achievement gaps are the result of racial "opportunity gaps"—racial differences in the cumulative set of educational opportunities children experience (Carter and Welner 2013). "Educational opportunities," in this view, include all experiences in a child's life, from birth onward, that provide opportunities for children to develop the social, behavioral, and cognitive capacities necessary to acquire the academic skills measured by school-based standardized math and reading tests. These include experiences in children's homes, childcare settings,

neighborhoods, peer groups, and schools.

Two features of this view are notable. First, in saying that test score gaps reflect *cumulative* processes, we emphasize that the gaps (at any given time) are not the result solely, or even largely, of school-based experiences. Although tests are administered in schools and measure skills included in formal schooling curricula, that does not mean they are produced by schools. Indeed, racial disparities in educational opportunities begin early in children's lives, even before school entry. These early disparities arise in part from large racial differences in average family income and educational resources that parents can provide at home, differences in neighborhood conditions that support learning, and differences in enrollment in high-quality early childhood educational programs (Bassok et al. 2016; Bassok and Galdo 2016; Magnuson et al. 2004; Valentino 2018). Residential segregation may also compound differences in family resources because it isolates minority families in higher poverty neighborhoods. Even among households with the same annual income, Blacks and Hispanics reside in lower-income neighborhoods than Whites (Pattillo 2005, 2013; Reardon, Fox, and Townsend 2015; Sharkey 2014). Families residing in economically disadvantaged neighborhoods may have less access to high-quality preschools (Barnett and Lamy 2013), fewer neighbors with high levels of education, more exposure to violence and crime, fewer social services, and fewer opportunities for extracurricular activities (Duncan and Magnuson 2005). Early learning programs are also highly segregated by race and ethnicity (Greenberg and Monnarez 2020), and state-level racial residential segregation is correlated with gaps in pre-kindergarten program quality (Valentino 2018). As a result, racial achievement gaps are already very large when children enter kindergarten (Bassok et al. 2016; Reardon and Portilla 2016).

And second, in saying that test score gaps reflect differences in *opportunities*, we underscore that test score gaps are not the result of innate group differences in cognitive skills or other genetic endowments. While differences in two *individual* children's academic performance or learning may reflect differences in both individual traits and educational opportunities, differences in group *average*

test scores and test score growth should be understood as reflecting between-group opportunity gaps, given that there are no between-group differences in average genetic endowments or innate academic ability (Nisbett, Aronson, Blair, Dickens, Flynn, Halpern and Turkheimer, 2012; Nisbett 2009; Nisbett 1998).

If the achievement gap at any one point in time is the result of cumulative differences in educational opportunities, then the *change* in the gap during a given period of childhood reflects differences in opportunities *during that period*. So, while schools are not solely responsible for racial achievement gaps, they may affect the extent to which the gaps grow during school years. For example, if White and Black children develop reading or math skills at different average rates (which is another way of saying that achievement gaps change) during school years, this implies that White and Black students have received unequal educational opportunities during those years.

Thus, we hypothesize that K-12 school segregation may widen racial achievement gaps over the schooling years by exposing students of different racial groups to inequitable schooling contexts and resources. First, because of the combination of school segregation and racial disparities in family income, Black and Hispanic students attend higher poverty schools, on average, than their White peers. High-poverty schools often have less-skilled, less-experienced, and less-qualified teachers than low-poverty and predominantly White schools (Darling-Hammond 2004; Peske and Haycock 2006). This is in part a result of patterns of teacher preferences, placement, and attrition. Teachers are more likely to exit high-poverty and high-minority schools, which often leaves these schools with more novice and uncredentialed teachers (Hanushek, Kain, and Rivkin 2004; Jackson 2009; Scafidi, Sjoquist, and Stinebrickner 2007). Similar sorting of students and teachers occurs within schools (Kalogrides and Loeb 2013). Though there is not yet definitive evidence, such racial disparities in access to high-quality teachers may lead to widening racial achievement gaps (Scafidi et al. 2007).

Second, schools with large proportions of minority and poor students may be less equipped to

support student achievement. For example, parents of students in high-poverty schools tend to have substantially less political, social, and economic capital that can be leveraged to support the school and its students relative to parents of students in low-poverty schools (Horvat, Weininger, and Lareau 2003; Lareau and McCrory Calarco 2012). Thus, there may be less potential for beneficial spillover effects of these various forms of capital on students in high-poverty schools. Students in high-poverty schools also have lower average academic skills at school entry than students attending schools with lower rates of poverty as a result of unequal early childhood opportunities (Ladd 2012); this may lead teachers in such schools to focus their instruction and curricula more on basic skills or remedial content. There may also be fewer advanced courses and curricular offerings (Martin, Karabel, and Jaquez 2005), leading to racial differences in students' opportunities to learn in school.

Finally, segregation may lead to differences in school funding between the schools of White and minority students. In states with weak compensatory school finance systems or inequitable distribution of funds, poorer school districts may have less funding than richer districts (Baker and Corcoran 2012). If minority students are disproportionately concentrated in poorer school districts, their schools will likely have fewer resources (Sosina and Weathers 2019; Weathers and Sosina 2022). Even in places where the funding for high- and low-poverty schools is nominally equal, high-poverty schools often have greater financial needs as a result of serving more students needing special education, English Learner, social work, counseling, and school-based health services (Baker and Corcoran 2012). Furthermore, wealthier (and often Whiter) school districts receive more private donations than less affluent (and often higher minority) school districts (Nelson and Gazley 2014). Compensatory state and federal revenue may not sufficiently account for such local revenue shortfalls in the context of increasing segregation (e.g., Weathers and Sosina 2022).

In sum, racial disparities in academic achievement are shaped by racial disparities in early childhood experiences, out-of-school experiences that occur throughout childhood, and experiences

within K-12 schools. While racial disparities in opportunities during the K-12 years may be shaped by both out-of-school factors and in-school experiences, schools are the primary providers of educational opportunities during that time. School segregation, therefore, may play a key role in shaping disparities in educational opportunities during the K-12 years. Our goal is to characterize how school segregation affects the *growth* of racial achievement gaps while children are in school, net of differences in family resources, residential segregation, and other controls, and to provide evidence regarding the mechanisms through which school segregation may lead to unequal educational opportunities.

PRIOR RESEARCH ON THE EFFECTS OF SCHOOL SEGREGATION

Trends in School Segregation

Studies documenting the extent of racial school segregation leading up to and following the *Brown v. Board of Education* (1954) decision generally show that Black-White segregation did not begin to decline in earnest until after 1968, following the *Green v. County School Board of New Kent County* Supreme Court decision (Reardon and Owens 2014). In 1968, segregation remained near its peak. Nationally, 64% of Black students attended schools with 90-100% minority students (Orfield 2001), and the average within-district dissimilarity index was approximately 0.80, indicating that 80% of Black students (or 80% of White students) would have to change schools in order for all schools to have identical racial enrollments (Logan, Zhang, and Oakley 2017; Reardon and Owens 2014). By the early 1980s, only 33% of Black students were in schools with 90-100% minority students (Orfield 2001), and the average Black-White dissimilarity index had dropped to 0.51 (Logan et al. 2017). Hispanic-White segregation was not thoroughly documented during this period; however, there is evidence that Hispanic isolation grew from 1968 through the early 1980s (Orfield 2001).

Since the 1980s, levels of racial segregation have been more stable. Black and Hispanic students are somewhat more racially isolated today compared with the 1980s. In 2016, about 40% of Black and

42% of Hispanic students were in schools with 90-100% minority peers, an 8-9 percentage point increase from 1988 (Orfield et al. 2016). This decline in racial isolation resulted from an increase in the proportion of minority students in the U.S., rather than a change in how evenly students are distributed among schools. The dissimilarity index—which measures the evenness of racial compositions across schools—has changed little or declined modestly in the last three decades (Fuller et al. 2019; Logan et al. 2017; see Reardon and Owens 2014 for a thorough discussion). In the largest districts in the U.S., however, racial segregation—particularly White-Black segregation—has grown substantially in recent decades. In the 100 districts serving the largest numbers of Black students (which collectively enroll 44% of Black students nationwide), the average level of segregation has grown by 35% since 1991 (Owens et al. 2022).

There is less information on the levels and long-term trends in racial economic segregation due to both data limitations and the fact that racial segregation *per se* was the focus of legal desegregation efforts. Jang (2022) shows that the national Black-White and Hispanic-White differences in exposure to school poverty declined in the last two decades (by 10% and 29%, respectively), though this decline is largely the result of large regional demographic shifts rather than local changes in between- and within-district patterns. In fact, racial economic segregation within large and diverse school districts has grown over this period (Fahle et al. 2020; Jang, 2022). That said, there is considerable variation in racial economic segregation across places: in some school districts, all students attend schools with similar poverty rates (racial economic segregation is near 0), while in others Black and Hispanic students attend schools with poverty rates that are as much as 50 percentage points higher than White students (racial economic segregation is above 0.5).

Desegregation, Resources, and Achievement

The literature on the effects of school desegregation in the 1960s and 1970s identifies unequal school funding as a primary mechanism linking racial segregation and educational and social outcomes in that era. From the 1960s through the 1980s, Black students gained access to more school resources and

were able to enroll in historically White and well-resourced schools as a result of school desegregation (Johnson 2019). For example, in Louisiana, not only did Black students gain access to additional school resources through enrolling in traditionally White schools, but also through significant changes in the state's school funding system that led to substantial increases in funding for the schools attended by Black students (Reber 2010). The expanded access to school resources, including higher per pupil expenditures and smaller student-to-teacher ratios, improved high school completion rates, educational attainment, socioeconomic status, and health outcomes for Black students (Anstreicher et al. 2022; Ashenfelter et al. 2006; Guryan 2004; Johnson 2019; Reber 2010). Given patterns of contemporary resegregation and the evidence that segregation is related to racial disparities in school district expenditures and revenue (Sosina and Weathers 2019; Weathers and Sosina 2022), contemporary segregation may still be linked to disparities in academic performance today.

Contemporary Segregation and Racial Gaps in Academic Achievement

The empirical literature assessing the relationship between contemporary racial segregation and achievement gaps generally finds a positive association between the two. Using SAT data from 1998 to 2001, Card and Rothstein (2007) find that Black-White SAT score gaps were larger in more residentially segregated metropolitan areas. Net of racial residential segregation, however, they found that racial school segregation had no independent association with racial gaps in SAT scores. In contrast, Reardon (2016), using data based on standardized test scores from all students (rather than a self-selected sample of SAT-takers) and models with a fuller set of control variables, found that school segregation is more predictive of metropolitan area racial achievement gaps than residential segregation in grades three through eight. Reardon (2016) also found that, among many dimensions of segregation, racial disparities in average school poverty rates (school racial economic segregation) were the most powerful correlates of metropolitan area racial achievement gaps. Net of racial economic segregation, racial school segregation *per se* was not associated with achievement gaps. This suggests that segregation is related to

achievement gaps because it concentrates minority students in high poverty schools. This finding is consistent with Owens (2018) study of income segregation, which found that metropolitan area economic segregation was positively associated with achievement gaps both between White and Black students and between economically advantaged and disadvantaged students.

Two additional studies provide further evidence regarding the association of racial segregation with achievement gaps or other educational disparities. Condron et al. (2013) assess the association of within-state, between-school racial segregation and White-Black gaps in National Assessment of Educational Progress (NAEP) scores between 1991 and 2009. They find that higher levels of within-state racial school segregation were associated with larger 4th-grade state-level NAEP achievement gaps, net of state and year fixed effects. Lutz (2011) shows that Black students' dropout rates and enrollment in private schools increased in school districts outside of the South after they were released from court-ordered desegregation mandates in the late 1990s or 2000s.

Summary of Reviewed Literature

Overall, the existing literature on segregation and student outcomes is relatively sparse. It shows that desegregation in the mid-to-late 20th century improved Black students' educational, economic, and social outcomes, primarily through the expansion of school resources. A few recent studies also show a clear association between more contemporary segregation (in the 1990s and 2000s) and achievement gaps. However, these studies have a key limitation: they generally do not distinguish between the size of gaps early in schooling and the growth of gaps as children move from grade to grade. A gap in test scores or graduation rates in middle or high school may result from both disparities in skills when children enter school and disparities in the rate at which children learn during school years. But school segregation can only affect the growth in disparities while children are in school; it cannot shape patterns that are evident at the start of schooling. Because the prior literature does not distinguish between initial gaps and the growth of gaps, it does not convincingly make the case that contemporary school segregation widens

achievement gaps. The correlations reported in the literature above between achievement gaps and school segregation may result from some unobserved factor that is correlated both with the size of achievement gaps when children enter school and the degree of school segregation. Moreover, prior studies primarily examine segregation at the state or metropolitan area level, rather than the school district level, and they provide little evidence about the mechanisms through which segregation operates.

We address each of these limitations in our analyses, described below. Most importantly, we focus on the association between segregation and the growth of achievement gaps during the schooling years. We also investigate several mechanisms through which school segregation may affect the grade-to-grade growth of achievement gaps. We examine both White-Black and White-Hispanic segregation and achievement gap patterns to assess the robustness of the patterns across racial groups. Finally, we study segregation within school districts rather than states or metropolitan areas, as districts have the most direct policy control (e.g., school attendance zones) over segregation patterns.

A STYLIZED CONCEPTUAL MODEL

A study of the relationship between school segregation and growth in achievement gaps is a study of the relationship between school segregation and the inequality of educational opportunities. Here we lay out a series of stylized models that form the basis for our estimation strategy (see Card and Rothstein, 2007, for additional discussion of this model).

Consider a stylized model that expresses academic performance (Y_{isd}) of student i in school s in district d as a function of student characteristics (including race, family background, and other out-of-school experiences, and denoted by the vector $\mathbf{X}_i$), school characteristics (denoted by the vector $\mathbf{Z}_s$), district characteristics (expressed here by a district fixed effect $\mathbf{\Lambda}_d$), and an independent, mean-zero error term e_{isd}:

$$Y_{isd} = \mathbf{X}_i\mathbf{B} + \mathbf{Z}_\mathrm{s}\mathbf{\Gamma} + \mathbf{\Lambda}_d + e_{isd}. \quad (1)$$

Taking the average value of this expression for both White and Black students in a given district d yields:

$$\begin{aligned}\bar{Y}_{wd} &= \bar{\mathbf{X}}_{wd}\mathbf{B} + \bar{\mathbf{Z}}_{wd}\mathbf{\Gamma} + \mathbf{\Lambda}_d \\ \bar{Y}_{bd} &= \bar{\mathbf{X}}_{bd}\mathbf{B} + \bar{\mathbf{Z}}_{bd}\mathbf{\Gamma} + \mathbf{\Lambda}_d,\end{aligned} \tag{2}$$

where $\bar{\mathbf{X}}_{wd}$ and $\bar{\mathbf{X}}_{bd}$ denote the average values of $\mathbf{X}$ among White and Black students, respectively, in district d. Taking the difference of these two expressions yields the White-Black gap in district d, denoted ΔY_d:

$$\Delta Y_d = \bar{Y}_{wd} - \bar{Y}_{bd} = (\bar{\mathbf{X}}_{wd} - \bar{\mathbf{X}}_{bd})\mathbf{B} + (\bar{\mathbf{Z}}_{wd} - \bar{\mathbf{Z}}_{bd})\mathbf{\Gamma} = (\Delta\mathbf{X}_d)\mathbf{B} + (\Delta\mathbf{Z}_d)\mathbf{\Gamma}. \tag{3}$$

Given the model of achievement described in (1), the White-Black gap in district d is a function of White-Black differences in individual characteristics ($\Delta\mathbf{X}_d = \bar{\mathbf{X}}_{wd} - \bar{\mathbf{X}}_{bd}$) and White-Black differences in average school characteristics ($\Delta\mathbf{Z}_d = \bar{\mathbf{Z}}_{wd} - \bar{\mathbf{Z}}_{bd}$). Note that the district characteristics do not enter into (3), as they are common to White and Black students.

If the vector $\mathbf{Z}$ contains a measure of school composition such as the percent of group g in school s, denoted P_s^g, then $\bar{P}_{wd}^g$ is simply the exposure index of White students to group g (the proportion of group g in the average White student's school in district d), and $\bar{P}_{bd}^g$ is the exposure of Black students to group g. Equation (3) would then show that the achievement gap (ΔY_d) depends on $\Delta P_d^g = \bar{P}_{wd}^g - \bar{P}_{bd}^g$, the difference in exposure of Whites and Blacks to group g. ΔP_d^g is a standard measure of segregation (Reardon and Owens 2014). If g denotes White or Black students, then ΔP_d^g is a measure of racial segregation; if g denotes poor students, then ΔP_d^g is a measure of racial economic segregation. This indicates that segregation will be associated with achievement gaps if achievement is described by model (1) and if school composition is associated with individual achievement.

If the vector $\mathbf{Z}$ contains a measure of some school characteristic that affects students' achievement (say, quality of instruction, denoted Q_s), then the achievement gap is a function of ΔQ_d, the difference in average instructional quality experienced by White and Black students in district d. Likewise,

if the vector $\mathbf{X}$ contains a measure of some individual or family characteristic that affects students' achievement (say, family income, denoted I_i), then the achievement gap is a function of $\Delta\mathrm{I}_d$, the White-Black difference in average family income in d.

This stylized model suggests that we can estimate the parameters of model (1) by fitting a regression model of the form suggested by equation (3):

$$\Delta\mathrm{Y}_d = (\Delta\mathbf{P}_d)\mathbf{A} + (\Delta\mathbf{X}_d)\mathbf{B} + (\Delta\mathbf{Z}_\mathrm{d})\mathbf{\Gamma} + u_d. \tag{4}$$

This model focuses on the average achievement gap at a given grade level as the key outcome. There are several challenges to using this model to obtain unbiased estimates of the effect of school segregation: omitted variables bias, reverse causality bias, and bias due to measurement error in the predictor variables.

Omitted variables bias is the most likely—and likely the largest—source of bias. If the school segregation measures ($\Delta\mathbf{P}_d$) are correlated with other unobserved factors that affect achievement gaps, the coefficients in the vector $\mathbf{A}$ will be biased. Potential confounders might include racial differences in family resources, neighborhood conditions, early childhood experiences, and educational opportunities, or racial discrimination and differential treatment (in schools or outside of schools). Some of these factors, such as differences in family socioeconomic resources and neighborhood segregation, are observable in available data and therefore can be included in the models. But others, such as differences in early childhood experiences and educational opportunities, are not easily observed. One way to address some forms of omitted variables bias is to reconfigure the models so that they focus on the growth in the achievement gap during school years rather than the magnitude of the gap at a given point in time.

To see how we do this, consider a modified version of the stylized model in equation (1), one that expresses academic performance (Y_{tisd}) at time t of student i in school s in district d as a function of the accumulated effects of potentially time-varying student characteristics ($\mathbf{X}$), school composition ($\mathbf{P}$), and

other school characteristics ($\mathbf{Z}$), accumulated time-varying district fixed effects ($\mathbf{\Lambda}$), a student fixed effect ($\boldsymbol{\eta}$), and an independent, mean-zero error term (e):

$$Y_{tisd} = \left(\sum_{k=0}^{t} \mathbf{P}_{sk}\right)\mathbf{A} + \left(\sum_{k=0}^{t} \mathbf{X}_{ik}\right)\mathbf{B} + \left(\sum_{k=0}^{t} \mathbf{Z}_{sk}\right)\mathbf{\Gamma} + \sum_{k=0}^{t} \mathbf{\Lambda}_{dk} + \boldsymbol{\eta}_i + e_{tisd}. \tag{5}$$

Taking the average value of this expression for both White and Black students in a given district d at a given time T, and then taking the White-Black difference yields an expression for the White-Black achievement gap at time T (denoted ΔY_{Td}):

$$\Delta Y_{Td} = \left(\sum_{k=0}^{T} \Delta\mathbf{P}_{kd}\right)\mathbf{A} + \left(\sum_{k=0}^{T} \Delta\mathbf{X}_{kd}\right)\mathbf{B} + \left(\sum_{k=0}^{T} \Delta\mathbf{Z}_{kd}\right)\mathbf{\Gamma} + \Delta\boldsymbol{\eta}_d, \tag{6}$$

Where $\Delta\mathbf{P}_{kd}$, $\Delta\mathbf{X}_{kd}$, and $\Delta\mathbf{Z}_{kd}$ are the White-Black disparities in $\mathbf{P}$, $\mathbf{X}$, and $\mathbf{Z}$, respectively, in district d during time period k. Given the model of achievement described in (5), the White-Black gap at time T in district d is a function of a) the accumulated effects of White-Black segregation (both racial and racial economic segregation); b) the accumulated effects of White-Black differences in individual characteristics (for example, White-Black differences in family income trajectories over their lives); c) the accumulated effects of White-Black differences in average school characteristics (for example, White-Black differences in exposure to experienced teachers); and d) White-Black differences in average student fixed effects. Note that the accumulated district characteristics do not enter into (6) because they are common to White and Black students.

A challenge in estimating the coefficients of interest ($\mathbf{\Gamma}$) from equation (6) is that we may not observe all relevant covariates, or we may not be able to observe their full sequence from time 0 to T. To partially address this, we can difference equation (6) with respect to time:

$$\delta\Delta Y_{Td} = \Delta Y_{Td} - \Delta Y_{(T-1)d} = (\Delta\mathbf{P}_{Td})\mathbf{A} + (\Delta\mathbf{X}_{Td})\mathbf{B} + (\Delta\mathbf{Z}_{Td})\mathbf{\Gamma}, \tag{7}$$

where $\delta\Delta Y_{Td} = \Delta Y_{Td} - \Delta Y_{(T-1)d}$ is the change in the White-Black achievement gap during grade T.

Under this model, the *change* in the achievement gap during grade T is a function of segregation during grade T as well as between-group differences in individual and school characteristics *during* grade T. Note that the temporal difference in equation (7) eliminates both the White-Black difference in fixed effects from the model and all values of the covariates prior to time T.

This stylized model is the basis for the cross-sectional models we use to estimate the association between segregation and the average growth of achievement gaps from third to eighth grade. We are interested in $\mathbf{A}$, the vector of coefficients on racial and racial economic segregation, and $\mathbf{\Gamma}$, the vector of coefficients on racial differences in school characteristics.

In practice, we may lack time-specific measures of some important individual and school characteristics, however, which may lead to bias in estimates of $\mathbf{\Gamma}$. To partially address this, we use panel data (where we have multiple observations, across grades, years, and subjects, within each district) and include district-grade, district-year, and district-subject fixed effects in these models, in addition to lagged measures of the achievement gap:

$$\delta\Delta Y_{Td} = \alpha\Delta Y_{(T-1)d} + \Delta\mathbf{P}_{Td}\mathbf{A} + \Delta\mathbf{X}_{Td}\mathbf{B} + \Delta\mathbf{Z}_{Td}\mathbf{\Gamma} + \mathbf{\Lambda}_{dg} + \mathbf{\Lambda}_{dy} + \mathbf{\Lambda}_{db} + u_{td}. \quad (8)$$

To the extent that $\Delta\mathbf{X}_{td}$, for example, does not vary within a district, net of grade, year, and subject fixed effects, the estimates of $\mathbf{\Gamma}$ will not be biased by the omission of $\Delta\mathbf{X}_{td}$ from the model. The lagged measures of the achievement gap ($\Delta Y_{(T-1)d}$) serve as a sufficient statistic for unobserved prior factors contributing to current achievement gaps. The panel models based on this stylized model are used to estimate the association between segregation and growth in achievement gaps during school years.

An additional potential source of bias in estimates of $\mathbf{A}$ from equation (8) is reverse causality bias. Reverse causality bias would be a concern if segregation were influenced by the presence of achievement gaps. If, for example, White parents opted out of schools with Black and Hispanic students more in districts with larger racial achievement gaps, the associations we observe between segregation and achievement gaps would partly reflect the effect of achievement gaps on segregation, rather than the

other way around. This is a larger concern in models like equation (4) above, which estimate the association between levels of segregation and the magnitude of gaps. It is much less likely that parents have sufficient information to respond systematically to changes in achievement gaps from one grade to another, so we view reverse causality bias as less of a concern when estimating the association between segregation and changes in gaps than when estimating the association between segregation and the size of gaps. Moreover, in the panel regression models, the parameter $\mathbf{A}$ is identified from within-district (between-grade and between-year) variation in segregation levels. Reverse causality bias would only occur in this case if segregation levels *in a given year and grade* were responsive to changes in *achievement gaps during that same year*. We view this as unlikely, as it is unclear how anyone—parents or school officials—would have clear information about how achievement gaps are changing during the year (since the changes are based on tests taken in the spring of the year) in time to change enrollment patterns prior to when segregation is measured (we compute it based on racial and economic background data measured in spring, when the tests are taken). Thus, reverse causality bias is unlikely to be a meaningful source of bias in our models, particularly the regression models estimating the association between segregation and changes in achievement gaps.

A third potential source of bias is a bias due to measurement error in $\mathbf{\Delta P}_{Td}$ or the other covariates in the models. If the segregation or control variables are measured with error, the coefficients may be biased. As we explain below (in the Data section), measurement error in the segregation measures or covariates is unlikely to be a significant source of bias, given that 1) the segregation measures are based on full enrollment data for each district; 2) systemic sources of measurement error in school composition will be absorbed by the fixed effects in the panel models; and 3) the measures of socioeconomic disparities include multiple redundant measures from distinct samples.

In sum, we use a series of cross-sectional and panel regression models with a vector of control variables to estimate the effect of school segregation on achievement gaps. We reason that if school

segregation affects achievement gaps, we would expect to observe that school segregation will be associated with the growth of achievement gaps as children progress through school after controlling for between-group differences in family background and neighborhood segregation. Because we use data with near-complete population coverage, our estimates are representative of the entire U.S. population of public elementary and middle schools, a substantial advantage over prior research. Nonetheless, the regression approach will yield biased estimates if not all confounding variables are included, so our estimates should be understood as potentially biased.[2]

DATA

Achievement Data

Our analysis requires estimates of average academic achievement, comparable across places, years, and grades, disaggregated by race. Our measures of average achievement come from a restricted version of the Stanford Education Data Archive Version 5.0 (SEDA 5.0; Reardon et al. 2021). SEDA provides average test score estimates and their standard errors for public schools, districts,[3] counties, and metropolitan statistical areas for all students and for racial, gender, and economic subgroups in math and ELA in grades 3 through 8 from the 2008-09 through 2018-19 school years. These estimates are constructed from the ED*Facts* state accountability test data (provided by the National Center for Education Statistics) and linked to a common scale using the state NAEP data (Reardon, Kalogrides, and Ho 2021). The test scores are standardized within grades and subjects to the national student-level distribution of scores.[4] For technical details on the SEDA data, see Fahle et al. (2021). From SEDA, we use

[2] While an experiment would provide unbiased causal estimates of the effect of segregation on achievement gaps, such an approach is not feasible given that there are no clear instruments for segregation that would meet the exclusion restriction.
[3] SEDA uses geographic school districts, rather than administrative school districts. Geographic school district estimates reflect the test scores of all public school students attending school within their geographic boundaries.
[4] Specifically, we use the "cohort scale" test scores from SEDA; for details, see Fahle et al. (2021).

estimates of Black, Hispanic, and White students' average test scores in all subjects, grades, and years available. We use the district-level data for our primary analyses and the county and metropolitan area data for supplementary analyses shown in the Appendix.

School Segregation Measures

We construct segregation measures using counts of students by race and by economic disadvantage in each school-grade-year from ED*Facts*.[5] Our primary racial segregation measure is the Black-White or Hispanic-White difference in exposure to Black and Hispanic ("minority") students. For example, we compute Black-White racial segregation in district d as:

$$\Delta P_d^m = \bar{P}_{bd}^m - \bar{P}_{wd}^m = \sum_{s \in d} \left(\frac{b_s}{B}\right) \pi_{ms} - \sum_{s \in d} \left(\frac{w_s}{W}\right) \pi_{ms} = \sum_{s \in d} \left(\frac{b_s}{B} - \frac{w_s}{W}\right) \pi_{ms}, \tag{9}$$

where b_s, w_s, B, and W are the number of Black and White students, respectively, in school s and the whole district, respectively, and where π_{ms} is the proportion of students in school s who are Black or Hispanic.

Similarly, we construct measures of racial economic segregation as the Black-White and Hispanic-White differences in exposure to poor students. For example, we compute Black-White racial economic segregation as:

$$\Delta P_d^p = \bar{P}_{bd}^p - \bar{P}_{wd}^p = \sum_{s \in d} \left(\frac{b_s}{B}\right) \pi_{ps} - \sum_{s \in d} \left(\frac{w_s}{W}\right) \pi_{ps} = \sum_{s \in d} \left(\frac{b_s}{B} - \frac{w_s}{W}\right) \pi_{ps} \tag{10}$$

where b_s, w_s, B, and W are defined as above and π_{ps} is the proportion of students in school s who are economically disadvantaged. We compute the segregation measures for each district in each year and grade. In the cross-sectional models, we use an unweighted average of these measures across grades (3-8) and years (2009-2019) within each district. In the panel models, we use the year- and grade-specific

[5] We use ED*Facts* data instead of the Common Core of Data because school-by-year-by-grade free/reduced-price lunch data are not included in the CCD.

estimates.

Because the segregation measures are not based on samples (we have race and economic disadvantage status data for all students in each school-grade-year), there is no sampling error in the segregation estimates. There are, however, some inconsistencies in how economic disadvantage is defined and measured across states, districts, and years. States' definitions of economic disadvantage differ slightly, though in most states free and reduced-price lunch eligibility is used as the measure of economic disadvantage. More importantly, reporting of free/reduced-price lunch eligibility in schools qualifying for the Community Eligibility Provision varies across states, districts, and years in some cases. This can lead to inconsistencies in the measurement of racial economic segregation, which may lead to bias in the estimated coefficients on segregation. However, such inconsistencies are unlikely to be a significant issue in the panel regression models we describe below, where the district-year fixed effects will absorb any systematic differences in the measurement of racial economic segregation across places and years. Any remaining measurement error in racial economic segregation would bias the estimates toward zero.

School Characteristics

Our exploratory models include a set of measures hypothesized to mediate the associations between segregation and achievement gaps. These include the Black-White and Hispanic-White differences in average student/teacher ratios computed from the 2009-2019 Common Core of Data (CCD)[6] and three other variables computed from the 2011-12, 2013-14, 2015-16, and 2017-18 Civil Rights Data Collection (CRDC)[7] data describing differences in school characteristics: the Black-White and Hispanic-White differences in the proportion of novice (first- or second-year) teachers in the average students' school; the Black-White and Hispanic-White differences in the proportion of chronically absent

[6] CCD universe surveys are available at https://nces.ed.gov/ccd/ccddata.asp.
[7] CRDC data are available at https://ocrdata.ed.gov/resources/downloaddatafile.

teachers (10+ days per school year) in the average students' school; and the Black-White and Hispanic-White differences in the proportion of students that attend schools that offer gifted programs. We average all variables across the available years to get a single value for each district included in the cross-sectional models.

Control Variables

In all models, we include a set of control variables. Most notably, we include (in our cross-sectional models) a rich set of measures of both the average socioeconomic status (SES) of families living in a school district and the White-Black (or White-Hispanic) difference in average SES among families in the district. Specifically, we include 21 measures of school district average SES and racial differences in SES as controls in the cross-sectional models. These data are derived from 2005-2019 ACS data and the 2000 Census data. The district average SES measures include: 1) log of median family income; 2) proportion of adults with a bachelor's degree or higher; 3) poverty rate; 4) unemployment rate; 5) SNAP receipt rate; 6) single female-headed household rate; 7) home ownership rate; and 8) proportion of adults in professional occupations.[8] We also include district White-Black (or White-Hispanic) differences in each of these measures.[9] Finally, we include 5 measures of racial differences in SES based on 2000 Census data (differences in log of median family income; proportion of adults with a bachelor's degree or higher; poverty rate; unemployment rate; and single female-headed household rate (SNAP receipt, home ownership, and professional occupation rates are not available at the school district level in the 2000 Census data we use).[10] We include these multiple measures to maximize the explanatory power of the

[8] These 8 measures are computed from ACS data, as reported in the EDGE data system, in each of three waves of data: 2005-09, 2010-2014, and 2015-2019; each measure is averaged over the three waves.

[9] Again, the measures are computed from three waves of 2005-2019 ACS data and averaged. In districts with small samples of White, Black, or Hispanic families, the disparity measures cannot be computed and are missing. We use empirical Bayes shrunken versions of all ACS derived SES measures so that so that the error-prone estimates from districts with small ACS samples do not overly influence the regression estimates.

[10] We include the 2000 Census measures both because they provide additional measures of racial disparities in SES (and so may help with the controls particularly in places where ACS samples are small and estimates are noisy) and because they provide measures of racial SES disparities earlier in the lives of the families and children represented in our sample.

SES control variables. We also include residential segregation measures as control variables in the cross-sectional models. Using tract-level data from the ACS,[11] we compute the Black-White and Hispanic-White racial segregation (differences in exposure to minority neighbors) and racial economic segregation (differences in exposure to poor neighbors). Our cross-sectional models also include the proportion of students in each district that are Black or Hispanic, obtained from 2008-09 through 2018-19 CCD data.

Because the panel models include district-by-grade and district-by year fixed effects, we include a more parsimonious set of control variables that we can observe varying within districts across both years and grades. These include racial composition (the proportion of Black students and the proportion of Hispanic students), the proportion of economically disadvantaged students, and the average school size.

Sample Restrictions and Data Limitations

Our analyses focus on the population of public school students in the U.S. There are roughly 13,030 public geographic school districts serving grades 3-8 in the United States. We drop 30 very small districts from our analytic sample for which SEDA does not include test score data from both White and Black (or Hispanic) students in any grade or year. We also drop districts for which one or more of the SES measures or race-specific SES measures are not available for the district. Because the ACS SES variables are based on population samples, the race-specific SES variables are not available for districts in the population of a given race is very small. As a result, we are missing SES disparity measures in many districts (4,680 districts are missing some of the White-Black SES disparity measures; 2,270 are missing some of the White-Hispanic SES disparity measures). Finally, we exclude districts missing any of the other control variables or the school characteristic variables (470 districts are dropped from the White-Black analyses; 1,130 from the White-Hispanic analyses).

Following these restrictions, our analytic sample for the White-Black achievement gap models

[11] ACS data were obtained at https://www.nhgis.org/. Tract-level ACS data are available as 5-year pooled samples. We use the 2005-2009 through 2015-2019 ACS data and average segregation across the 11 5-year pooled samples within each unit.

contains 7,850 school districts; for the White-Hispanic achievement gap models, the sample includes 9,600 school districts.[12] Although the analytic samples include estimated achievement gaps from only about two-thirds of all public school districts in the U.S., the excluded districts are, on average, very small, and enroll relatively few minority students: 93% of Black (and 79% of White) and 90% of Hispanic (and 89% of White) public school students in grades 3-8 in the U.S. are enrolled in districts included in the two analytic samples, respectively. Thus our estimates are generally reflective of patterns of school segregation and achievement gaps in the districts of the vast majority of public school students in the U.S.

ANALYTIC METHODS

The stylized models above motivate a set of regression models in which we regress achievement gaps or changes in achievement gaps on measures of segregation (between-group differences in average racial and socioeconomic school composition) and between-group differences in individual, family, and school characteristics.

Cross-Sectional Models

We first fit a series of cross-sectional models. Given the structure of the SEDA data, in which there are multiple grade-year-subject observations nested within districts, we fit these models as hierarchical linear models. The data are structured so that there are up to 132 grade-year-subject observations per district (we have data for up to 6 grades, 11 years, and 2 subjects per district) and two observations (one for White and one for either Black or Hispanic students, as relevant) per grade-year-subject. We treat the two groups' observations as nested within grade-year-subject cells and the grade-year-subject cells as nested within districts. We define $cohort = year - grade$, so that the model includes a set of parameters describing within-cohort changes in achievement gaps across grades. Specifically, we fit models of the following form:

[12] Sample sizes are rounded to the nearest 10, per IES disclosure requirements.

$$\hat{Y}_{sgcbd} = \alpha_{0gcbd} + \alpha_{1gcbd}\left(white_s - p_{gcbd}\right) + e_{sgcbd}$$

$$\alpha_{0gcbd} = \beta_{00d} + \beta_{01d}(grade) + \beta_{02d}(cohort) + \beta_{03d}(math) + r_{0gcbd}$$
$$\alpha_{1gcbd} = \beta_{10d} + \beta_{11d}(grade) + \beta_{12d}(cohort) + \beta_{13d}(math)$$

$$\beta_{00d} = \gamma_{000} + \mathbf{X\Gamma}_{000} + u_{00d}$$
$$\beta_{01d} = \gamma_{010} + \mathbf{X\Gamma}_{010} + u_{01d}$$
$$\beta_{02d} = \gamma_{020} + \mathbf{X\Gamma}_{020} + u_{02d}$$
$$\beta_{03d} = \gamma_{030} + \mathbf{X\Gamma}_{030} + u_{03d}$$
$$\beta_{10d} = \gamma_{100} + \mathbf{X\Gamma}_{100} + u_{10d}$$
$$\beta_{11d} = \gamma_{110} + \mathbf{X\Gamma}_{110} + u_{11d}$$
$$\beta_{12d} = \gamma_{120} + \mathbf{X\Gamma}_{120} + u_{12d}$$
$$\beta_{13d} = \gamma_{130} + \mathbf{X\Gamma}_{130} + u_{13d}$$

$$e_{sgcbd} \sim N\left(0, Var\left(\hat{Y}_{sgcbd}\right)\right); r_{0d} \sim N(0, \sigma^2); [u_{00d}, \ldots, u_{13d}] = \mathbf{U}_d \sim MVN\left(0, \boldsymbol{\tau}^{\mathbf{2}}\right). \quad (11)$$

In this model, $\hat{Y}_{sgcbd}$ is the estimated standardized mean test score for subgroup s in grade g, cohort c, and subject b in district d (or county or metropolitan area in additional models); $white$ is a binary variable indicating whether an observation refers to White students; and p_{gcbd} is the proportion of White students in grade g, cohort c, and subject b in district d (among White and Black or Hispanic students only, as relevant). The coefficients α_{0gcbd} and α_{1gcbd} describe, respectively, the average test score (among White and Black or Hispanic students, as relevant) and the difference in average scores between White and Black or Hispanic students in grade g, cohort c, and subject b in district d. The $u_{\ldots d}$ are multivariate normal district-level errors with means of 0 and covariance matrix $\boldsymbol{\tau}^{\mathbf{2}}$ to be estimated; r_{0d} is a normally distributed within-district error term with a mean of 0 and variance σ^2 to be estimated; and e_{sgcbd} is the mean 0 normally distributed sampling error in $\hat{Y}_{sgcbd}$. We treat the sampling variance of $\hat{Y}_{sgcbd}$ as known and set it equal to the squared estimated standard error of $\hat{Y}_{sgcbd}$. We fit the model using maximum likelihood using the HLM program (Raudenbush et al. 2019).

In the second level of the model, $grade$ is a continuous variable indicating the tested grade (ranging from 3 to 8), centered at 3; $cohort$, defined as $year - grade$, is a continuous variable

indicating the year students entered first grade (ranging from 2001 to 2016), centered at 2011; and $math$ is an indicator equal to 1/2 if the subject is math and -1/2 if the subject is reading. Centering the grade, cohort, and math variables in this way improves the convergence of the models and ensures that the level-2 intercepts can be interpreted as measures of the average achievement and achievement gap in grade 3 (averaged over cohorts and subjects). The coefficients β_{10d} and β_{11d} indicate the two outcomes of interest here: the average achievement gap in grade 3 (averaged over cohorts and subjects) and the average within-cohort, across-grade growth rate of the gap (averaged over subjects and cohorts) in district d, respectively.

In the third level of the model, $\mathbf{X}$ is a vector of (year-, grade-, and subject-invariant) covariates consisting of the segregation measures and controls described above. Our focus is on the level 3 equations describing the achievement gap in third grade and its growth rate from grade 3 to 8, β_{10d} and β_{11d}. The key parameters of interest here are the coefficients in the vectors $\mathbf{\Gamma_{100}}$ and $\mathbf{\Gamma_{110}}$ that correspond to the measures of school segregation included in $\mathbf{X}$. These describe the cross-district relationship between our two measures of school segregation and achievement gaps and their growth across grades. As noted above, because these models rely on between-district variation in segregation levels, the estimates are subject to bias from omitted district-level covariates that are correlated with segregation levels and achievement gaps or their growth.

Panel Models

Our second set of models uses within-district variation in segregation levels (across grades and years) to estimate the association between segregation levels and contemporaneous changes in achievement gaps. To do so, we fit fixed effects panel models of the form:

$$\delta\Delta \mathrm{Y}_{sgybd} = \sum_{j=1}^{2} \alpha_j \Delta Y_{s(g-j)(y-j)bd} + \mathbf{X}_{sgyd}\mathbf{B} + \Delta\mathbf{Z}_{sgyd}\mathbf{\Gamma} + \eta_{gd} + \lambda_{yd} + \theta_{bd} + u_{sgybd}, \quad (12)$$

where $\delta\Delta Y_{sgybd}$ is the estimated change in the achievement gap during grade g and year y for subgroup combination s (White-Black and White-Hispanic) in subject b in district d (district, county, metropolitan area) and $\Delta Y_{s(g-j)(y-j)bd}$ is the gap for the same cohort of students j grades/years earlier. The lagged achievement gap measures both serve as sufficient statistics for accumulated prior disparities in opportunities and help to address measurement error-induced regression to the mean (Koedel, Mihaly, and Rockoff 2015; Sass, Semykina, and Harris 2014). The White-Black and White-Hispanic achievement gaps are computed as the difference in the means between the two racial groups (White minus minority) within a district-grade-year-subject. $\mathbf{X}$ is a vector of grade-year-district controls (including percent Black, Hispanic, and economically disadvantaged students, and average school size); $\Delta\mathbf{Z}$ is a vector of segregation measures; η_{gd} is a vector of district-by-grade fixed effects; λ_{yd} is a vector of district-by-year fixed effects; θ_{bd} is a vector of district-by-subject fixed effects; and u_{sgybd} is a normally-distributed homoscedastic error term.

The parameter of interest is $\mathbf{\Gamma}$, the association between segregation in a given year/grade and the change in the achievement gap during that same year/grade, conditional on the model. Because these models rely only on within-district variation in segregation levels (across grades and years), they are not biased by the omission of district-level confounding variables. Moreover, the inclusion of district-by-grade and district-by-year fixed effects eliminates bias due to omitted year- or grade-specific confounders within a district. For example, segregation is generally higher in earlier grades because students are spread over more schools in early grades, while achievement gaps are generally smaller in earlier grades, though the relationship between these two patterns may not be causal. The inclusion of district-grade fixed effects removes the bias that such patterns might cause.

That said, the estimates from the panel models will be biased if there are omitted confounders that vary within years and grades. In particular, we do not have grade- and year-varying measures of race-specific socioeconomic status, so we cannot control for within-district changes in racial socioeconomic

disparities that might be correlated with changes in within-district segregation and changes in achievement gaps. However, the primary drivers of changes in racial disparities in socioeconomic status would likely be factors such as local economic changes or changes in district demographics; in large part, demographic and economic changes would be expected to change economic disparities in all grades similarly. Such changes would be absorbed by the district-year fixed effects in the model and so would not lead to bias, however. Nonetheless, given the possibility of some unobserved confounder, we take the estimates from the panel models to be suggestive, but not definitive, of the average causal effect of within-district segregation on the contemporaneous growth of within-district racial achievement gaps.

RESULTS

Descriptive Statistics: Cross-Sectional Model Samples

Descriptive statistics for the school district cross-sectional model samples are shown in Table 1. The White-Black analytic sample includes 1,295,950 grade-year-subject observations from 7,850 school districts. The White-Hispanic analytic sample includes 1,742,280 observations from 9,600 school districts.

[Table 1 about here]

The average White-Black achievement gap in grade 3 among school districts is 0.496 standard deviation units and the standard deviation of the mean achievement gap across districts is 0.214, which implies that there are districts where the gaps are reasonably small (less than one-fifth of a standard deviation) and others where they are close to 1 standard deviation. The White-Hispanic achievement gap is slightly smaller on average (0.344 standard deviation units). Again, there is substantial variation in these gaps among districts similar in magnitude to that of the Black-White gap (the standard deviation of the mean achievement gap is approximately 0.2). Thus, by third grade, most school districts already have modest to large racial achievement gaps that reflect the substantial inequities in childhood educational opportunities between Black or Hispanic students and their White peers.

From third to eighth grade, the White-Black and White-Hispanic achievement gaps do not change much on average. The average gap growth rate of the White-Black gap is -0.002 standard deviations per grade and the White-Hispanic gap is -0.014 standard deviations per grade. However, there is substantial variation in the growth rates of the gaps (a standard deviation of approximately 0.02 for both the White-Black and White-Hispanic samples). This suggests that there are districts where the White-Black and White-Hispanic gaps are closing at a rate of 0.04 standard deviations per grade (or by 0.2 standard deviations from third to eighth grade); and others where the gaps widen at a similar pace. This variation suggests that school districts play a role in shaping achievement gaps—both positively (where gaps narrow) and negatively (where gaps widen).

The school segregation measures show that the average Black student's school enrolls 1.8 percentage points more poor students and 2.3 percentage points more Black and Hispanic students than the average White student's school in the same district. Similarly, the average Hispanic student's school enrolls 1.6 percentage points more poor students and 1.8 percentage points more Black and Hispanic students than the average White student's school. These average differences are small in part because they are not weighted to account for district size. Small districts with only one or a few schools (where segregation is generally very low) are given the same weight as large urban districts (where segregation is generally high). These small average differences also mask substantial variation in these measures. For example, the Black-White gap in exposure to poor students ranges from essentially zero (no difference in exposure) to approximately 0.5 (a 50 percentage point difference in the poverty rates of Black and White students' schools). These two segregation measures are also highly correlated (see Figure 1): within-district racial segregation is almost invariably accompanied by racial economic segregation.

[Figure 1 about here]

Equivalent descriptive statistics for the county and metropolitan area samples used in supplemental analyses are shown in Appendix Table A1. In comparison to the district samples, counties

and metropolitan areas have larger average gaps and higher rates of both racial and racial economic school segregation. In part, these differences are because counties and metropolitan areas are larger than districts, allowing for greater segregation and less socioeconomic homogeneity.

Descriptive Statistics: Panel Model Samples.

Table 2 provides descriptive statistics for the school district panel model samples. These samples include many fewer district-grade-year-subject observations and somewhat fewer districts than those used in the cross-sectional models because the panel model samples are restricted to district-grade-year observations for which we observe both White and Black or Hispanic achievement *and* the 1- and 2-year lagged versions of both. Some districts with very small Black or Hispanic populations lack measures of the group's mean achievement in consecutive years and grades, making them unusable in the panel models. As a result, relative to the cross-sectional sample, the panel model sample includes districts that serve, on average, larger shares of Black and Hispanic students. In total, the Black-White sample includes 223,500 grade-year-subject observations from 6,820 districts, and the Hispanic-White sample includes 308,550 observations from 9,410 districts.

[Table 2 about here]

Table 2 reports both the overall standard deviation and the within-district standard deviation of each measure.[13] The panel models rely on within-district variation, so we focus on that here. The outcome used in the panel models is the within-cohort and -subject grade-to-grade change in the White-minority achievement gap. For White-Black gaps, the average within-cohort grade-to-grade gap change is near zero (-0.002). For the White-Hispanic gaps, the average within-cohort grade-to-grade gap change is -

[13] Because the observed standard deviation of changes in achievement gaps is inflated due to sampling and estimation error in the gap estimates, we estimate the true total and within-unit standard deviations using multilevel precision-weighted random effects models, which allow us to decompose the total variance in observed gap changes into between-unit, within-unit, and measurement error components. For the covariates, we estimate the within-unit standard deviation of each variable by computing the root mean square error from a regression of the variable on a set of unit fixed effects.

0.015. The standard deviations of changes in the gap within districts (0.007 for the White-Black gap and 0.006 for the White-Hispanic gap) indicate that the rate of change in the achievement gap varies across grades and years.

The average observation in our panel samples has slightly higher average segregation than that in our cross-sectional models. This results from the fact that larger districts, which tend to be more segregated, typically have more grade-year-subject cells included in the panel sample than smaller and less diverse districts. Nonetheless, the same pattern is apparent: Black and Hispanic students are exposed to larger proportions of poor and minority schoolmates than their White peers. Again, the panel models rely on the fact that these measures vary within the district. The within-district standard deviations of the difference in exposure to minorities (Black and Hispanic) and the difference in exposure to poor schoolmates are generally 0.02 to 0.03 for both racial group comparisons. Comparable descriptive statistics for the county and metropolitan area panel model samples are shown in Appendix Table A2.

Bivariate Associations

The bivariate associations between achievement gaps, gap growth, and the two types of school segregation measures are shown in Figures 2 and 3. Two patterns are notable. First, differences in exposure to minority schoolmates (racial segregation, shown in Figure 2) and differences in exposure to school poverty (racial economic segregation, shown in Figure 3) are both positively associated with grade 3 gaps. However, the correlations between racial economic segregation and the gaps (0.41 for the White-Black sample and 0.43 for the White-Hispanic sample) are stronger than those between racial segregation and the gaps (0.32 for the White-Black sample and 0.37 for the White-Hispanic sample).

[Figures 2 & 3 about here]

Second, the bivariate associations between segregation and growth follow a somewhat similar pattern. Correlations between racial differences in exposure to minority schoolmates and gap growth are modest and positive (0.21 for the White-Black sample and 0.24 for the White-Hispanic sample).

Correlations between racial differences in exposure to school poverty and the average gap growth are slightly stronger for the Black-White sample (0.27) and about the same for the Hispanic-White sample (0.24). Overall, these bivariate associations suggest (1) that places with larger racial differences in exposure to poor and minority schoolmates—more racial and racial economic school segregation—tend to have larger racial achievement gaps and larger growth in racial achievement gaps; and (2) that differences in exposure to poverty may be more important for the development of achievement gaps than are differences in exposure to minority students. That said, these bivariate associations do not account for other factors that may shape achievement gaps during school years, a concern we address in the regression models.

Racial Segregation Predicts Achievement Gaps and Gap Growth

In the cross-sectional models, racial differences in exposure to minority students are strongly and positively associated with White-Black and White-Hispanic achievement gaps in grade 3 (Table 3, column C1). These associations remain strong even after controlling for racial differences in SES, overall SES, racial composition, and residential segregation (Table 3, column C2). In these models, the estimates imply that, net of racial socioeconomic differences and demographic characteristics, a difference of 0.10 in district racial school segregation (measured as the Black or Hispanic-White difference in exposure to minority schoolmates) is associated with a roughly 0.06 standard deviation difference in the White-Black or White-Hispanic grade 3 achievement gap.

[Table 3 about here]

As noted above, we are primarily interested in the associations between school segregation and the growth of achievement gaps, as they are less likely to be confounded by unobserved early childhood experiences and opportunities than associations between segregation and achievement gaps in grade 3. The association between racial school segregation and within-cohort growth in the White-Black and White-Hispanic gaps is weaker but still evident across aggregations in the cross-sectional models (C1 and

C2). In the models with controls (C2), the coefficient on growth is approximately 0.03 for the White-Black sample and 0.02 for the White-Hispanic sample. A difference of 0.10 in district racial segregation is therefore associated with a 0.015 standard deviation change in the Black-White achievement gap from grade 3 to 8 (0.003 standard deviations/grade times five grades) and a 0.010 standard deviation change in the Hispanic-White achievement gap from grade 3 to 8 (0.002 standard deviations/grade time five grades).

The panel models yield larger estimates of the associations between racial school segregation and growth in the White-Black and White-Hispanic gaps. In models including controls (Table 3, column P2), the estimated coefficients are generally around 0.21 for the White-Black gap growth models and 0.26 for the White-Hispanic gap growth models. The panel models leverage only within-district variation in segregation levels across grades and years, net of district-grade, district-subject, and district-year fixed effects. As such, the resulting estimates have a stronger causal warrant than the estimates from the cross-sectional models. These coefficients show that White-Black and White-Hispanic achievement gaps grow more in grades and years when the schools in a district are more racially segregated, relative to the average grade or year. We estimate that a 0.10 increase in the difference in exposure to minority schoolmates (relative to the average grade or year) would correspond to 0.021 to 0.026 standard deviation per year differences in the White-Black and the White-Hispanic gap growth rates, respectively, within a school district. Over the course of 3rd to 8th grade, this equates to approximately a 0.1 standard deviation change in the gap. Results for the county and metropolitan area samples are shown in Appendix Table A3; similar patterns hold.

Racial Segregation Operates Through Racial Economic Segregation

The next set of cross-sectional models in Table 3 estimates the partial associations of achievement gaps and gap growth with racial economic school segregation. In model C4, racial school segregation is no longer positively and significantly associated with the grade 3 achievement gap or with

the growth of the achievement gap from grade 3 to 8. Instead, Black-White and Hispanic-White differences in exposure to school poverty, are positively associated with gaps in grade 3, net of racial differences in exposure to minority schoolmates. For the growth of gaps, this pattern holds in the Black-White sample, but not in the Hispanic-White sample where the high collinearity in model C4 between racial and racial economic segregation inflates the standard errors and renders the conditional associations between both segregation measures and achievement gap growth too imprecise for clear conclusions.

Again, the panel models suggest that the association between segregation and the rate at which racial achievement gaps increase is large (P4). Achievement gaps grow faster in grades and years with larger racial differences in exposure to school poverty. But the growth of the achievement gap is not associated with racial differences in exposure to minority schoolmates once we include racial differences in exposure to school poverty in the model. Therefore, these models strongly suggest that, while racial segregation plays a role in shaping racial achievement gaps, it does so primarily because it leads to differences in exposure to poor schoolmates. Similar results are found for counties and metropolitan areas (Appendix Table A3).

How do Observable Differences in School Characteristics Relate to Segregation?

Thus far, our model results suggest that racial segregation predominantly affects racial achievement gap growth through differences in exposure to school poverty. Guided by some of our theorized mechanisms, we estimate a series of cross-sectional models to test whether differences in a few rough indicators of school quality can explain the association between differences in exposure to school poverty and gap growth.

Table 4 provides correlations among the segregation measures and measures of differences in school resources. Differences in exposure to novice teachers, exposure to chronically absent teachers, and school offerings of gifted programs are all significantly, positively correlated with both Black-White

and Hispanic-White gaps in exposure to poor schoolmates and minority schoolmates, though the correlations are moderate at best (and weak in the case of chronically absent teachers and gifted program offerings). Districts with higher levels of racial and racial economic segregation have, on average, larger racial differences in these school quality measures. In contrast, differences in student-teacher ratios are weakly negatively associated with segregation in districts.

[Table 4 about here]

Although there are modest and statistically significant bivariate correlations between the measures of differences in school quality and the segregation measures, none of the measures of Black-White differences in school quality are significant predictors of White-Black gap growth in the full analytic sample (Table 5, model C5, analytic sample). Moreover, the coefficient on the Black-White difference in exposure to school poverty in model C5, which includes measures of differences in school and teacher characteristics, is very similar to that in model C4, which does not include such measures. The Hispanic-White difference in exposure to school poverty is not a significant predictor of gap growth in models C4 or C5; however, the Hispanic-White difference in exposure to novice teachers is a significant predictor of gap growth in model C5.

[Table 5 about here]

Some of the covariates are poorly measured in districts with few students of any given group (Black, Hispanic, or White); this may lead to attenuation bias in the estimated coefficients in model C5. To address this, we re-estimate these models using a reduced sample that includes only districts with at least 100 Black or Hispanic and 100 White students in grades 3-8 combined (averaged over the years). We first fit model C4 to the reduced sample to verify that the coefficients on the segregation measures were similar to those in the full analytic sample. We then fit model C5, which includes the measures of school quality disparities. In the reduced samples, minority-White differences in exposure to novice teachers and to chronically absent teachers are associated with both the size and growth of the White-Black and

White-Hispanic achievement gaps. These findings suggest that racial differences in students' exposure to teacher experience and absenteeism (or other teacher characteristics that these measures are proxies for) may play a role in shaping achievement gaps during school years. However, even in this sample, the association between racial economic segregation and the growth of achievement gaps is reduced only modestly (by 20% in the White-Black models and not significantly in the White-Hispanic models) by the inclusion of the school quality disparity measures.

It is important to note, however, that the school quality disparity measures we include represent a very limited set of school characteristics and are at best only rough proxies for differences in school quality. In other words, our analyses cannot definitively rule out the possibility that differences in school resources contribute substantially to the association between racial economic segregation and achievement gaps.

DISCUSSION

At the outset of this paper, we asked: does racial school segregation today limit Black and Hispanic students' educational opportunities? Our analyses indicate that the answer, in short, is yes. Using scores from hundreds of millions of state accountability tests taken in the last decade by elementary and middle school students in thousands of school districts, we find a very strong link between racial school segregation and academic achievement gaps. Achievement gaps grow faster in more segregated school systems during elementary and middle school relative to less segregated school systems. This pattern holds when we control for racial residential segregation and a large vector of racial disparities in socioeconomic characteristics.

Notably, the association between racial segregation and achievement gaps appears to operate entirely through racial economic segregation (racial differences in exposure to poor schoolmates). Despite the strong association between race and poverty and the strong correlation between racial

segregation and racial economic segregation, we have sufficient data to distinguish their separate associations with achievement gaps. And once we control for racial economic segregation, racial segregation *per se* is no longer predictive of achievement gaps or the growth in the gaps. This implies that high-poverty schools provide, on average, less educational opportunity than low-poverty schools. Segregation matters, therefore, because it concentrates Black and Hispanic students in high-poverty schools, not because of the racial composition of their schools.

To make this concrete, consider the New York City and Atlanta school districts, two of the most racially segregated districts in the country. Both districts are equally highly racially segregated: Black students in both attend schools where the average proportion of minority students is about 53 percentage points higher than in their White peers' schools. But in Atlanta, racial economic segregation is 32 percentage points higher than in New York: The Black-White difference in school poverty rates is 25 percentage points in New York, compared to 57 points in Atlanta. Correspondingly, the White-Black achievement gap grows 50% faster in Atlanta (where it grows by 0.37 standard deviations from third to eighth grade) than in New York City (where it grows by 0.25 standard deviations).

Our finding that racial economic segregation that leads to widening test score gaps implies that students learn less, on average, when they attend higher poverty schools. This result appears at odds with a recent, well-designed study (Lauen and Gaddis 2013) which found no significant effect of classroom-level poverty rates on academic achievement. One key distinction between our study and that study is that we examine *school* poverty rates rather than *classroom* poverty rates. It may be that the mechanisms through which school poverty affects academic learning and performance are school-level processes, not classroom-level processes. As we noted above, high-poverty schools may attract less experienced or skilled teachers and principals, they may offer fewer advanced courses, have fewer support services and counselors, and may have access to less social and political capital. Each of these mechanisms might create between-school differences in learning opportunities but would not necessarily

create within-school differences in learning environments between higher- and lower-poverty classrooms. The Lauen and Gaddis (2013) findings do not rule out between-school effects of school poverty (since their preferred models rely largely on within-school variation in classroom poverty rates).

Our analyses are inconclusive, however, on the question of *why* the concentration of minority students in high-poverty schools leads to larger achievement gaps. One possibility is that high-poverty schools attended by minority students tend to have fewer resources, less experienced and skilled teachers, and less challenging curricula than low-poverty schools. Our analyses show that this is the case. In more segregated school districts, White students are more likely to be concentrated in schools with more experienced teachers, teachers who are less frequently absent, and more gifted and talented programs, for example. Moreover, we find that disparities in teacher characteristics (teacher experience and absenteeism) are predictive of the growth of the achievement gap. In the White-Black models, they explain roughly 20% of the association between segregation and the growth of achievement gaps, which suggests that teacher characteristics may play a role in shaping the growth of achievement gaps.

That said, our measures of school resources and teacher skills are relatively crude and certainly do not fully capture all aspects of school quality, so our models do not clearly quantify the extent to which the effect of segregation on the growth of achievement gaps is due to differences in school resources, teacher skills, or curricula. Moreover, even the associations between teacher characteristics and the growth of the achievement gap that we observe are not conclusive with respect to mechanisms. Although racial achievement gaps grow faster in school systems where Black or Hispanic students disproportionately attend schools with novice and chronically absent teachers, that does not necessarily mean that teachers themselves are the source of unequal educational opportunity. The presence of many novice or absent teachers, for example, may be a signal of poor school leadership or of a school culture that does not foster sustained engagement of its teaching staff; these and related aspects of schools' cultures and climates may lead to unequal expectations and opportunities and resulting achievement

gaps. Our findings are suggestive that operational school features play a role in the growth of the gaps, but they are not dispositive regarding the exact mechanisms.

A second possibility is that racial economic segregation results in the concentration of minority students in schools where their schoolmates have low prior test scores relative to the schools where more White students are enrolled. This might lead to differences in curricula or instructional rigor, differences in teachers' expectations of students, differences in student motivation, or differences in school norms and academic press (Lee and Smith 1999). In a set of analyses not shown, we add a measure of the racial disparity in schoolmates' prior test scores to panel model P4, reasoning that, within a district, achievement gaps might grow more in grades and years when the disparity between Black or Hispanic students' schoolmates' prior test scores and those of White students is larger. However, we find no evidence supporting this hypothesis. Although segregation is almost always accompanied by large differences in the prior academic performance of minority and White students' schoolmates, these differences are not positively and significantly associated with the growth of achievement gaps.

A third possibility is that racial economic segregation limits the possibility that Black or Hispanic students develop social friendship networks that include higher-income students. Recent research demonstrates that access to such friendship networks facilitates upward economic mobility for low-income children (Chetty et al. 2022a, 2022b), though that work is silent on the mechanisms through which friendships with higher-income peers operate. If friendship networks also affect academic outcomes (for example, by expanding students' sense of their possible futures; giving them access to their peers' social capital; developing their academic habits and habitus) then lowered racial economic segregation might narrow the growth of achievement gaps at least partly by altering opportunities for such friendships. That said, friendship network mechanisms may not be able to account for the results evident in the panel models, since friendship networks may evolve over a longer time frame than may be driven by year-to-year variation in segregation patterns.

It is important to note that this study is not without several limitations. First, our estimates may suffer from bias. Omitted variable bias is the biggest concern. School segregation is in part the product of lingering effects of historical government policy (e.g., redlining), existing policies (e.g., school assignment), and family choices (and constraints) on where to live and where to enroll their children in school (Hanushek and Rivkin 2009). These systematic factors complicate the ability to isolate exogenous variation in segregation that can be used to identify the causal effect of segregation on achievement gaps. While our fixed effects panel models reduce the possibility of omitted variable bias, they do not eliminate it. One possible important omitted variable is district-grade-year specific racial poverty rates. If racial disparities in economic disadvantage vary across years and grades within a district (net of district-year and district-grade systematic variation), this may lead to correlated variation in both racial economic segregation and racial disparities in learning rates, which would bias our estimates. Our data do not allow us to measure grade-by-year specific racial differences in economic disadvantage, however. There may be other sources of bias, such as reverse causality bias and bias due to measurement error. These are unlikely to be major sources of bias, for reasons noted above, particularly in the panel models.

Second, the panel models rely on relatively limited variation in segregation levels between grades and years within a district; while we find that even these modest differences in segregation levels are associated with different rates of achievement gap growth, inferences about what would happen if we changed segregation more substantially rely on an extrapolation of the estimates. If large changes in segregation affect achievement gap growth via different mechanisms than do the small grade-to-grade differences in segregation we observe in the data, then our results may not generalize well to the effects of larger changes. Finally, our measures of school characteristics are quite limited, so we are unable to test many possible hypotheses regarding the mechanisms through which racial economic segregation is associated with growing achievement gaps.

Future research might extend and improve our work here in several ways. First, concerns about

bias in the estimated effects of segregation could be alleviated by identifying credible instruments that cause exogenous differences in segregation levels across districts or within districts across grades or years. Another approach to identifying the effects of segregation would be to use fall and spring administrations of standardized tests to distinguish change in achievement gaps during the school year from changes that occur in the summer. Second, future research could do more to identify the mechanisms through which school segregation shapes disparities in educational outcomes. Better measurement of a robust set of potential mechanisms will be essential to such work. That may require original data collection or a focus on data that are richer than those available in national data sources, even if that limits the geographic generalizability of the data. And third, future research might also investigate heterogeneity in the effects of segregation across different kinds of school districts and local contexts to better understand the conditions under which segregation is most harmful.

Implications

There is a substantial sociological literature (e.g., Downey, von Hippel, and Broh 2004) investigating whether schooling is an equalizing or disequalizing force in society. In one view, schools are segregated and unequal, replicating and reinforcing broader societal socioeconomic and racial stratification by providing unequal educational opportunities to children of different backgrounds (Bowles and Gintis 1976). In the other view, inequalities among schools are far smaller than socioeconomic inequalities among families and neighborhoods, making schools one of the most equalizing social institutions (Alexander, Entwisle, and Bedinger 1994; Alexander, Entwisle, and Olson 2001, 2007; Downey and Condron 2016). Some recent research suggests that the extent to which schooling is equalizing or disequalizing varies substantially across places: in some school districts, schools appear to provide much more educational opportunity for low-income students than in others (Reardon, 2019).

Our analyses here do not directly address the question of whether schools are equalizing or disequalizing. But our findings do provide evidence that the extent to which schools are disequalizing

institutions is linked to the degree of segregation in the system. We find that, all else equal, racial segregation—particularly racial economic segregation—exacerbates already unequal educational opportunities stemming from large racial disparities in family resources, neighborhood conditions, and early childhood education (Fryer and Levitt 2004; Reardon and Portilla 2016). Moreover, factors such as family socioeconomic disparities and residential segregation may contribute to the growth of racial achievement gaps while children are in school. The fact that the coefficients on school racial segregation are substantially reduced in our cross-sectional models when we add controls for residential segregation and socioeconomic disparities indicates that those factors play a significant role in shaping the size and growth of racial achievement gaps.

Our findings suggest that reducing school segregation might be one arrow in a broader quiver of social policies to reduce educational inequality. While a full discussion of how we might do that is beyond the scope of this paper, we offer a few comments here. One lever for reducing school segregation is school district policies: districts have some control over which students attend which schools. And our findings suggest that the target of districts' student assignment policies should be the reduction of racial economic segregation, not simply racial segregation *per se*. But eliminating within-district segregation is challenging, particularly in large, residentially segregated districts like New York City (Shapiro 2021), where many students would have to travel long distances to create a more integrated schooling system and where the goals of integrated schools often conflict with goals to create neighborhood-based school communities. Although we have effectively reduced within-district segregation in the past with court mandates to end *de jure* school segregation, most court-ordered desegregation plans have been dismissed by the courts in recent decades (Fiel and Zhang 2019; Lutz 2011; Reardon et al. 2012).

But the systematic reduction of racial segregation cannot be left entirely to individual school districts. Roughly two-thirds of school segregation is the result of *between-district residential segregation* patterns (Jang 2022; Owens, Reardon, and Jencks 2016; Reardon, Yun, and Eitle 2000), a dimension of

segregation that no form of within-district integration strategy can change. This means that, even if every school district in the country changed its student assignment policies so that all schools in a district had exactly the same racial and economic composition, total racial segregation in the country would be reduced by only one-third.

But if reducing within-district school segregation is challenging, then reducing between-district segregation through the courts or via educational policy is even more so. Although there is certainly evidence that federal and state policies and actions have contributed to between-district school segregation (see, for example, Rothstein 2017), the courts have generally not been willing to allow inter-district desegregation remedies (Holme, Finnigan, and Diem 2016; Siegel-Hawley 2014). State policies to consolidate school districts might help to reduce segregation by making it possible to combine or integrate schools that had previously been in separate, demographically different districts. But recent trends have worked against this possibility: several recent reports or studies examining school district secession over at least the last decade highlight a pattern in which school districts created by secessions were, on average, more affluent and enrolled a higher proportion of White students than the districts from which they seceded, thereby aggravating between-district segregation (Cooperstock 2022; EdBuild 2017; Richards 2020; United States Government Accountability Office 2022).

To systematically reduce school segregation, be it racial or racial economic segregation, we will likely need strategies that operate beyond the education policy landscape to ensure equality of educational opportunity for all students in K-12 schools across America. One key to systematically reducing racial *school* segregation is reducing racial *residential* segregation, particularly between-district residential segregation. Housing policies are one approach, but such policies are ultimately limited by racial economic inequality. As long as Black and Hispanic families have dramatically lower wealth and lower average incomes than White families (Wolff 2018), a competitive housing market will lead to high levels of racial segregation (even if there were no discrimination in the housing and lending market and

no racial animus among Whites that led some Black and Hispanic families to prefer predominantly non-White communities).

In the long term, reducing racial income and wealth inequality (and economic inequality generally) may be a more effective way to systematically decrease both residential and school racial segregation (and racial economic school segregation) than strategies that focus solely on reducing residential segregation via housing policy or strategies that focus on reducing school segregation via education policies. Reducing racial economic inequality could both reduce disparities in educational opportunities in early childhood and could reduce residential and school segregation. But changing patterns of racial income and wealth inequality is a formidable project that depends to some extent on reducing racial disparities in educational outcomes. Thus, near-term strategies, like efforts to directly reduce school segregation, may be necessary—albeit not sufficient—to achieve the long-term goal of full racial equality of educational opportunity in America.

REFERENCES

Akee, Randall, Maggie R. Jones, and Sonya R. Porter. 2019. "Race Matters: Income Shares, Income Inequality, and Income Mobility for All U.S. Races." *Demography* 56(3):999–1021. doi: 10.1007/s13524-019-00773-7.

Alexander, Karl L., Doris R. Entwisle, and Samuel D. Bedinger. 1994. "When Expectations Work : Race and Socioeconomic Differences in School Performance." *Social Psychology* 57(4):283–99.

Alexander, Karl L., Doris R. Entwisle, and Linda S. Olson. 2001. "Schools, Achievement, and Inequality: A Seasonal Perspective. *Educational Evaluation and Policy Analysis*." Educational Evaluation and Policy Analysis 23(2):171–91.

Alexander, Karl L., Doris R. Entwisle, and Linda Steffel Olson. 2007. "Lasting Consequences of the Summer Learning Gap." *American Sociological Review* 72:167–80.

Anstreicher, Garrett, Jason Fletcher, and Owen Thompson. 2022. *The Long Run Impacts of Court-Ordered Desegregation*. 29926. Cambridge, MA.

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.

Baker, Bruce D., and Sean P. Corcoran. 2012. *The Stealth Inequities of School Funding: How State and Local School Finance Systems Perpetuate Inequitable Student Spending.* Washington, D.C.

Barnett, W. Steven, and Cynthia E. Lamy. 2013. "Achievement Gaps Start Early: Preschool Can Help." Pp. 98–110 in *Closing the Opportunity Gap: What America Must do to Give Every Child an Even Chance*, edited by P. L. Carter and K. G. Welner. Oxford: Oxford University Press.

Bassok, Daphna, Jenna E. Finch, RaeHyuck Lee, Sean F. Reardon, and Jane Waldfogel. 2016. "Socioeconomic Gaps in Early Childhood Experiences." *AERA Open* 2(3):1–22. doi: 10.1177/2332858416653924.

Bassok, Daphna, and Eva Galdo. 2016. "Inequality in Preschool Quality? Community-Level Disparities in Access to High-Quality Learning Environments." *Early Education and Development* 27(1):128–44. doi: 10.1080/10409289.2015.1057463.

Bowles, Samuel, and Herbert Gintis. 1976. *Schooling in Capitalist America: Educational Reform and the Contradictions of Economic Life.* New York: Basic Books.

Card, David, and Jesse Rothstein. 2007. "Racial Segregation and the Black-White Test Score Gap." *Journal of Public Economics* 91:2158–84.

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

Chetty, Raj, Matthew O. Jackson, Theresa Kuchler, Johannes Stroebel, Nathaniel Hendren, Robert Fluegge, Sara Gong, Federico Gonzalez, Armelle Grondin, Matthew Jacob, Drew Johnston, Martin Koenen, Eduardo Laguna-Muggenburg, Florian Mudekereza, Tom Rutter, Nicolaj Thor, Wilbur Townsend, Ruby Zhang, Mike Bailey, Pablo Barberá, Monica Bhole, and Nils Wernerfelt. 2022a. "Social Capital I: Measurement and Associations with Economic Mobility." *Nature* 608(August 2022):108–21. doi: 10.1038/s41586-022-04996-4.

Chetty, Raj, Matthew O. Jackson, Theresa Kuchler, Johannes Stroebel, Nathaniel Hendren, Robert Fluegge, Sara Gong, Federico Gonzalez, Armelle Grondin, Matthew Jacob, Drew Johnston, Martin Koenen, Eduardo Laguna-Muggenburg, Florian Mudekereza, Tom Rutter, Nicolaj Thor, Wilbur Townsend, Ruby Zhang, Mike Bailey, Pablo Barberá, Monica Bhole, and Nils Wernerfelt. 2022b. "Social Capital II: Determinants of Economic Connectedness." *Nature* 608(August 2022):122–34.

Condron, Dennis J., Daniel Tope, Christina R. Steidl, and Kendralin J. Freeman. 2013. "Racial Segregation and the Black/White Achievement Gap, 1992 to 2009." *The Sociological Quarterly* 54(1):130–57.

Cooperstock, Alexandra. 2022. "The Demographics of School District Secession." *Social Forces*. doi: 10.1093/sf/soac069.

Darling-Hammond, Linda. 2004. "Inequality and the Right to Learn: Access to Qualified Teachers in California's Public Schools." *Teachers College Record* 106(10):1936–66. doi: 10.1111/j.1467-9620.2004.00422.x.

Downey, Douglas B., and Dennis J. Condron. 2016. "Fifty Years since the Coleman Report: Rethinking the Relationship between Schools and Inequality." *Sociology of Education* 89(3):207–20. doi: 10.1177/0038040716651676.

Downey, Douglas B., Paul T. von Hippel, and Beckett A. Broh. 2004. "Are Schools the Great Equalizer? Cognitive Inequality during the Summer Months and the School Year." *American Sociological Review* 69(5):613–35. doi: 10.1177/000312240406900501.

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. doi: 10.1353/foc.2005.0004.

EdBuild. 2017. Fractured: *The Breakdown of America's School Districts*. Jersey City.

Fiel, Jeremy E., and Yongjun Zhang. 2019. "With All Deliberate Speed: The Reversal of Court-Ordered School Desegregation, 1970–2013." *American Journal of Sociology* 124(6):1685–1719. doi: 10.1086/703044.

Fryer, Roland G., and Steven D. Levitt. 2004. "Understanding the Black-White Test Score Gap in the First Two Years If School." *The Review of Economics and Statistics* 86(2):447–64.

Fuller, Bruce, Yoonjeon Kim, Claudia Galindo, Shruti Bathia, Margaret Bridges, Greg J. Duncan, and Isabel García Valdivia. 2019. "Worsening School Segregation for Latino Children?" *Educational Researcher* 48(7):407–20. doi: 10.3102/0013189X19860814.

Greenberg, Erica, and Tomas Monnarez. 2020. *Segregated from the Start: Comparing Segregation in Early Childhood and K-12 Education.* Washington, D.C.

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

Hanushek, Eric A., John F. Kain, and Steven G. Rivkin. 2004. "Why Public Schools Lose Teachers." *The Journal of Human Resources* 39(2):326–54. doi: 10.2307/3559017.

Hanushek, Eric A., and Steven G. Rivkin. 2009. "Harming the Best : How Schools Affect the Black – White Achievement Gap." *Journal of Policy Analysis and Management* 28(3):366–93. doi: 10.1002/pam.

Holme, Jennifer Jellison, Kara S. Finnigan, and Sarah Diem. 2016. "Challenging Boundaries, Changing Fate? Metropolitan Inequality and the Legacy of Milliken." *Teachers College Record* 118(3):1–40.

Horvat, Erin McNamara, Elliot B. Weininger, and Annette Lareau. 2003. "From Social Ties to Social Capital: Class Differences in the Relations between Schools and Parent Networks." *American Educational Research Journal* 40(2):319–51. doi: 10.3102/00028312040002319.

Jackson, C. Kirabo. 2009. "Student Demographics, Teacher Sorting, and Teacher Quality: Evidence from the End of School Desegregation." *Journal of Labor Economics* 27(2):213–56. doi: 10.1086/599334.

Jang, Heewon. 2021. *Racial Economic Segregation among U.S. Public Schools*, 1991-2019. Stanford, CA.

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

Kalogrides, Demetra, and Susanna Loeb. 2013. "Different Teachers, Different Peers: The Magnitude of Student Sorting Within Schools." *Educational Researcher* 42(6):304–16. doi: 10.3102/0013189X13495087.

Koedel, Cory, Kata Mihaly, and Jonah E. Rockoff. 2015. "Value-Added Modeling: A Review." *Economics of Education Review* 47:180–95. doi: 10.1016/j.econedurev.2015.01.006.

Ladd, Helen F. 2012. "Presidential Address: Education and Poverty: Confronting the Evidence." *Journal of Policy Analysis and Management* 31(2):203–27. doi: 10.1002/pam.

Lafortune, Julien, Jesse Rothstein, and Diane W. Schanzenbach. 2018. "School Finance Reform and the Distribution of Student Achievement." *American Economic Journal: Applied Economics* 10(2):1–26.

Lareau, Annette, and Jessica McCrory Calarco. 2012. "Class, Cultural Capital, and Institutions: The Case of Families and Schools." Pp. 61–86 in *Facing Social Class: How Societal Rank Influences Interaction*,

edited by S. T. Fiske and H. R. Markus. New York: Russell Sage Foundation.

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):943–79. doi: 10.1086/668408.

Lee, Valerie E., and Julia B. Smith. 1999. "Social Support and Achievement for Young Adolescents in Chicago: The Role of School Academic Press." *American Educational Research Journal* 36(4):907–45. doi: 10.3102/00028312036004907.

Logan, John R., Weiwei Zhang, and Deirdre Oakley. 2017. "Court Orders, White Flight, and School District Segregation, 1970-2010." *Social Forces* 95(3):1049–75. doi: 10.1093/sf/sow104.

Lutz, Byron. 2011. "The End of Court-Ordered Desegregation." *American Economic Journal: Economic Policy* 3(2):130–68.

Magnuson, Katherine A., Marcia K. Meyers, Christopher J. Ruhm, and Jane Waldfogel. 2004. "Inequality in Preschool Education and School Readiness." *American Educational Research Journal* 41(1):115–57. doi: 10.3102/00028312041001115.

Martin, Isaac, Jerome Karabel, and Sean W. Jaquez. 2005. "High School Segregation and Access to the University of California." *Educational Policy* 19(2):308–30. doi: 10.1177/0895904804274058.

Nelson, Ashlyn Aiko, and Beth Gazley. 2014. "The Rise of School-Supporting Nonprofits." *Education Finance and Policy* 9(4):541–66.

Nisbett, Richard. 1998. "Race, Genetics, and IQ." in *The Black-White Test Score Gap*, edited by C. Jencks and M. Phillips. Washington, D.C.: Brookings Institution Press.

Orfield, Gary. 2001. *Schools More Separate: Consequences of a Decade of Resegregation*. Cambridge, MA.

Orfield, Gary, Jongyeon Ee, Erica Frankenberg, and Genevieve Siegel-Hawley. 2016. *Brown at 62: School Segregation by Race, Poverty and State.* Los Angeles, CA.

Orfield, Gary, John Kucsera, and Genevieve Siegel-Hawley. 2012. *E Pluribus … Separation*. Los Angeles, CA.

Owens, Ann. 2018. “Income Segregation Between School Districts and Inequality in Students’ Achievement.” *Sociology of Education* 91(1):1–27.

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

Owens, Ann, Sean F. Reardon, Demetra Kalogrides, Heewon Jang, and Thalia Tom. 2022. *TRENDS IN RACIAL / ETHNIC AND ECONOMIC*. Los Angeles.

Pattillo, Mary. 2005. “Black Middle-Class Neighborhoods.” *Annual Review of Sociology* 31:305–29. doi: 10.1146/annurev.soc.29.010202.095956.

Pattillo, Mary. 2013. Black Picket Fences: *Privilege and Peril among the Black Middle Class*. Second. Chicago, IL: The University of Chicago Press.

Peske, Heather G., and Kati Haycock. 2006. T*eaching Inequality: How Poor and Minority Students Are Shortchanged on Teacher Quality*. Washington, D.C.: Education Trust.

Raudenbush, Stephen W., Anthony S. Bryk, Yuk F. Cheong, and Richard T. Congdon. 2019. “HLM 8 for Windows.”

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

Reardon, Sean F., Lindsay 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. doi: 10.1177/0002716215576104.

Reardon, Sean F., Elena T. Grewal, Demetra Kalogrides, and Erica Greenberg. 2012. “Brown Fades : The End of Desegregation and the Resegregation of American Public Schools.” *Journal of Policy Analysis and Management* 31(4):876–904. doi: 10.1002/pam.

Reardon, Sean F., Demetra Kalogrides, and Andrew D. Ho. 2021. “Validation Methods for Aggregate-Level Test Scale Linking: A Case Study Mapping School District Test Score Distributions to a Common

Scale." *Journal of Educational and Behavioral Statistics* 46(2):138–67. doi: 10.3102/1076998619874089.

Reardon, Sean F., and Ann Owens. 2014. "60 Years after Brown: Trends and Consequences of School Segregation." *Annual Review of Sociology* 40:199–218. doi: 10.1146/annurev-soc-071913-043152.

Reardon, Sean F., and Ximena A. Portilla. 2016. "Recent Trends in Income, Racial, and Ethnic School Readiness Gaps at Kindergarten Entry." *AERA Open* 2(3):1–18. doi: 10.1177/2332858416657343.

Reardon, Sean F., Joseph P. Robinson-Cimpian, and Ericka S. Weathers. 2015. "Patterns and Trends in Racial/Ethnic and Socioeconomic Academic Achievement Gaps." Pp. 491–509 in *Handbook of Research in Education Finance and Policy*, edited by H. F. Ladd and M. E. Goertz. New York: Routledge.

Reardon, Sean F., John T. Yun, and Tamela M. Eitle. 2000. "The Changing Structure of School Segregation : Measurement and Evidence of Metropolitan-Area School Segregation, 1989-1995." *Population (English Edition)* 37(3):351–64.

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

Richards, Meredith P. 2020. "The Racial/Ethnic and Socioeconomic Dynamics of Public School District Secession, 1995-2015." *Teachers College Record* 122(5):1–20.

Rothstein, Richard. 2017. *The Color of Law: A Forgotten History of How Our Government Segregated America*. New York: Liveright Publishing Corporation.

Sass, Tim R., Anastasia Semykina, and Douglas N. Harris. 2014. "Value-Added Models and the Measurement of Teacher Productivity." *Economics of Education Review* 38:9–23. doi: 10.1016/j.econedurev.2013.10.003.

Scafidi, Benjamin, David L. Sjoquist, and Todd R. Stinebrickner. 2007. "Race, Poverty, and Teacher Mobility." *Economics of Education Review* 26(2):145–59. doi: 10.1016/j.econedurev.2005.08.006.

Shapiro, Elizabeth. 2021. “New York Schools Are Segregated. Will the Next Mayor Change That?” *New York Times*, January 29.

Sharkey, Patrick. 2014. “Spatial Segmentation and the Black Middle Class.” *American Journal of Sociology* 119(4):903–54. doi: 10.1086/674561.

Siegel-Hawley, Genevieve. 2014. “Mitigating Milliken? School District Boundary Lines and Desegregation Policy in Four Southern Metropolitan Areas, 1990-2010.” *American Journal of Education* 120(3):391–433. doi: 10.1086/675570.

Sosina, Victoria E., and Ericka S. Weathers. 2019. “Pathways to Inequality: Between-District Segregation and Racial Disparities in School District Expenditures.” *AERA Open* 5(3):1–15. doi: 10.1177/2332858419872445.

United States Government Accountability Office. 2022. *K-12 Education: Student Population Has Significantly Diversified, But Many Schools Remain Divided Along Racial, Ethnic, and Economic Lines*. Washington, D.C.

Valentino, Rachel. 2018. “Will Public Pre-K Really Close Achievement Gaps? Gaps in Prekindergarten Quality Between Students and Across States.” *American Educational Research Journal* 55(1):79–116. doi: 10.3102/0002831217732000.

Weathers, Ericka S., and Victoria E. Sosina. 2019. *Separate Remains Unequal: Contemporary Segregation and Racial Disparities in School District Revenue*. 19–02. Stanford.

Weathers, Ericka S., and Victoria E. Sosina. 2022. “Separate Remains Unequal: Contemporary Segregation and Racial Disparities in School District Revenue.” *American Educational Research Journal* XX(X):1–34. doi: 10.3102/00028312221079297.

Wolff, Edward N. 2018. *The Decline of African-American and Hispanic Wealth since the Great Recession*. 25198. Cambridge, MA. doi: 10.3386/w25198.

TABLES

Table 1. Means, Standard Deviations, and Sample Sizes Used in Cross-Sectional Models

	White-Black		White-Hispanic	
	Mean	SD	Mean	SD
White-Minority Gap, Mean Achievement	0.496	0.214	0.344	0.199
White-Minority Gap, Achievement Growth Across Grades	-0.002	0.021	-0.014	0.019
Minority-White Gap in Exposure to Poor Schoolmates	0.018	0.046	0.016	0.044
Minority-White Gap in Exposure to Minority (Black+Hispanic) Schoolmates	0.023	0.058	0.018	0.048
Minority-White Differences in Exposure to Poor Neighbors	0.015	0.030	0.009	0.021
Minority-White Differences in Exposure to Minority Neighbors	0.036	0.070	0.022	0.043
Proportion Black	0.101	0.175	0.081	0.156
Proportion Hispanic	0.144	0.195	0.148	0.198
Proportion BA+ (ACS)	0.251	0.142	0.243	0.137
White-Minority Difference in Proportion BA+ (ACS)	0.069	0.094	0.107	0.077
Proportion BA+ (2000 Census)	0.211	0.151	0.205	0.146
White-Minority Difference in Proportion BA+ (2000 Census)	0.059	0.216	0.096	0.204
Median income (Ln $) (ACS)	10.893	0.342	10.885	0.329
White-Minority Difference in Median income (Ln $) (ACS)	0.366	0.175	0.216	0.124
Median income (Ln $) (2000 Census)	10.806	0.344	10.795	0.334
White-Minority Difference in Median income (Ln $) (2000 Census)	0.388	0.573	0.326	0.567
Professional Occupation Rate (ACS)	0.347	0.031	0.346	0.029
White-Minority Difference in Professional Occupation Rate (ACS)	0.076	0.019	0.159	0.012
Home Ownership Rate (ACS)	0.727	0.061	0.731	0.057
White-Minority Difference in Home Ownership Rate (ACS)	0.228	0.027	0.176	0.016
Poverty Rate (ACS)	0.130	0.068	0.128	0.065
White-Minority Difference in Poverty Rate (ACS)	-0.130	0.061	-0.095	0.046
Poverty Rate (2000 Census)	0.134	0.098	0.133	0.096
White-Minority Difference in Poverty Rate (2000 Census)	-0.121	0.210	-0.110	0.231
Single Mother Rate (ACS)	0.165	0.064	0.157	0.062
White-Minority Difference in Single Mother Rate (ACS)	-0.245	0.051	-0.072	0.027
Single Mother Rate (2000 Census)	0.186	0.092	0.175	0.088
White-Minority Difference in Single Mother Rate (2000 Census)	-0.197	0.252	-0.032	0.219
SNAP Receipt Rate (ACS)	0.106	0.063	0.102	0.061
White-Minority Difference in SNAP Receipt Rate (ACS)	-0.143	0.044	-0.086	0.031
Unemployment Rate (ACS)	0.070	0.023	0.068	0.023
White-Minority Difference in Unemployment Rate (ACS)	-0.059	0.032	-0.016	0.016
Unemployment Rate (2000 Census)	0.038	0.030	0.038	0.032
White-Minority Difference in Unemployment Rate (2000 Census)	-0.040	0.131	-0.030	0.126
N, Units	7,850		9,600	
N, Observations	1,295,950		1,742,280	

NOTE: Sample sizes are rounded to the nearest 10, per IES disclosure requirements. Summary statistics are calculated using one observation per unit (district, county, metropolitan area).

SOURCE: U.S. Department of Education, National Center for Education Statistics, ED*Facts* Assessment Data, "State Achievement by Performance Levels," years 2009-2019, authors' calculations; U.S. Department of Commerce, Bureau of the Census, American Community Survey (ACS), survey years 2005-09 through 2015-19, authors' calculations; U.S. Department of Education, National Center for Education Statistics, The NCES Common Core of Data (CCD), "Public Elementary/Secondary School Universe Survey," survey years 2008-09 through 2018-19, authors' calculations.

Table 2. Means, Standard Deviations, and Sample Sizes Used in Panel Models

	White-Black			White-Hispanic		
	Mean	Overall SD	Within Unit SD	Mean	Overall SD	Within Unit SD
Sample in Models Predicting White-Black and White-Hispanic Achievement Gaps						
Change in Achievement Gap Relative to Prior Year	-0.002	0.012	0.007	-0.015	0.011	0.006
Minority-White Gap in Exposure to Poor Schoolmates	0.022	0.059	0.029	0.016	0.050	0.024
Minority-White Gap in Exposure to Minority (Black+Hispanic) Schoolmates	0.030	0.073	0.028	0.019	0.054	0.024
Proportion Black	0.151	0.197	0.017	0.092	0.156	0.014
Proportion Hispanic	0.141	0.182	0.021	0.170	0.205	0.025
Proportion Economically Disadvantaged	0.504	0.233	0.049	0.492	0.223	0.050
Average Grade Size	39.4	15.3	4.2	35.3	16.1	4.1
N, Units		6,820			9,410	
N, Observations		223,500			308,550	

NOTES: Summary statistics are calculated using all observations for all units (district, county, metropolitan area); The data used for the panel models include one observation for each unit-grade-year-subject. The models are based on an unbalanced panel; Mean and SDs of the change in achievement gap are estimated using HLM with precision weights to deal with measurement error. Sample sizes are rounded to the nearest 10, per IES disclosure requirements.
SOURCE: U.S. Department of Education, National Center for Education Statistics, ED*Facts* Assessment Data, "State Achievement by Performance Levels," years 2009-2019, authors' calculations; U.S. Department of Education, National Center for Education Statistics, The NCES Common Core of Data (CCD), "Public Elementary/Secondary School Universe Survey," survey years 2008-09 through 2018-19, authors' calculations.

Table 3. Achievement Gaps and Differences in Exposure to Minority and Poor Schoolmates

	White-Black Gap Models							
	Cross-Sectional Models				Panel Models			
	C1	C2	C3	C4	P1	P2	P3	P4
Coefficients on Grade 3 Gap								
Minority-White Difference in Exposure to	1.338 ***	0.562 ***		0.067				
Minority Schoolmates	(0.044)	(0.046)		(0.077)				
Minority-White Difference in Exposure to			0.835 ***	0.769 ***				
Poor Schoolmates			(0.057)	(0.096)				
Coefficients on Growth of Gap								
Minority-White Difference in Exposure to	0.070 ***	0.027 ***		0.000	0.206 ***	0.208 ***		-0.026
Minority Schoolmates	(0.006)	(0.008)		(0.013)	(0.026)	(0.026)		(0.035)
Minority-White Difference in Exposure to			0.042 ***	0.042 *			0.334 ***	0.351 ***
Poor Schoolmates			(0.010)	(0.017)			(0.026)	(0.035)
Controls Included?		X	X	X		X	X	X
N (Districts)	7,850				6,820			
	White-Hispanic Gap Models							
	Cross-Sectional Models				Panel Models			
	C1	C2	C3	C4	P1	P2	P3	P4
Coefficients on Grade 3 Gap								
Minority-White Difference in Exposure to	1.637 ***	0.640 ***		0.171				
Minority Schoolmates	(0.043)	(0.049)		(0.093)				
Minority-White Difference in Exposure to			0.760 ***	0.602 ***				
Poor Schoolmates			(0.053)	(0.102)				
Coefficients on Growth of Gap								
Minority-White Difference in Exposure to	0.084 ***	0.017 *		0.012	0.262 ***	0.261 ***		0.056
Minority Schoolmates	(0.006)	(0.009)		(0.017)	(0.026)	(0.026)		(0.036)
Minority-White Difference in Exposure to			0.017	0.006			0.318 ***	0.282 ***
Poor Schoolmates			(0.009)	(0.018)			(0.025)	(0.034)
Controls Included?		X	X	X		X	X	X
N (Districts)	9,600				9,410			

* p<.05; ** p<.01; *** p<.001

NOTES: All models also include measures of grade (centered on grade 3), cohort (centered on 2011) and math (centered on .5). Control variables in cross-sectional models include black-white or Hispanic-white difference in exposure to minority neighbors and poor neighbors, overall and white-black or white-

Hispanic difference in SES variables (proportion BA+, logged median income, proportion in professional occupations, poverty rates, proportion of single mother headed households, SNAP receipt rates, unemployment rates, and home ownership rates), proportion black, and proportion Hispanic. All panel models include the 1- and 2-year lags of the gaps; control variables in panel models P2-P4 include proportion black, proportion Hispanic, proportion economically disadvantaged, and average school size. Sample sizes are rounded to the nearest 10, per IES disclosure requirements.
SOURCE: U.S. Department of Education, National Center for Education Statistics, ED*Facts* Assessment Data, "State Achievement by Performance Levels," years 2009-2019, authors' calculations; U.S. Department of Commerce, Bureau of the Census, American Community Survey (ACS), survey years 2005-09 through 2015-19, authors' calculations; U.S. Department of Education, National Center for Education Statistics, The NCES Common Core of Data (CCD), "Public Elementary/Secondary School Universe Survey," survey years 2008-09 through 2018-19, authors' calculations.

Table 4. Correlations between Segregation and School Quality Measures

	Black-White Gap in Exposure to ECD Students	Black-White Gap in Exposure to Minority Students	Hispanic-White Gap in Exposure to ECD Students	Hispanic-White Gap in Exposure to Minority Students
Minority-White Difference in Exposure to Poor Schoolmates	1.000 ***	0.863 ***	1.000 ***	0.914 ***
Minority-White Difference in Exposure to Minority Schoolmates	0.863 ***	1.000 ***	0.914 ***	1.000 ***
Minority-White Difference in Exposure to Black Schoolmates	0.680 ***	0.889 ***	0.400 ***	0.582 ***
Minority-White Difference in Exposure to Hispanic Schoolmates	0.494 ***	0.367 ***	0.875 ***	0.871 ***
Minority-White Difference in Exposure to Novice Teachers	0.504 ***	0.518 ***	0.376 ***	0.402 ***
Minority-White Difference in Exposure to Chronically Absent Teachers	0.163 ***	0.174 ***	0.127 ***	0.136 ***
Minority-White Difference in Schools' Student/Teacher Ratios	-0.065 ***	-0.047 ***	-0.162 ***	-0.140 ***
White-Minority Difference in Schools' Offerings of Gifted Programs	0.173 ***	0.194 ***	0.126 ***	0.127 ***
N(Districts)	7,850		9,600	

*** p<.001.

NOTE: Sample sizes are rounded to the nearest 10, per IES disclosure requirements.

SOURCE: U.S. Department of Education, National Center for Education Statistics, ED*Facts* Assessment Data, "State Achievement by Performance Levels," years 2009-2019, authors' calculations; U.S. Department of Commerce, Bureau of the Census, American Community Survey (ACS), survey years 2005-09 through 2015-19, authors' calculations; U.S. Department of Education, National Center for Education Statistics, The NCES Common Core of Data (CCD), "Public Elementary/Secondary School Universe Survey," survey years 2008-09 through 2018-19, authors' calculations.

Table 5. Achievement Gaps and School Resource Disparities

	White-Black Gap Models				White-Hispanic Gap Models		White-Hispanic Gap Models	
	Analytic Sample		Reduced Sample		Analytic Sample		Reduced Sample	
	C4	C5	C4	C5	C4	C5	C4	C5
Coefficients on Grade 3 Gap								
Minority-White Difference in Exposure	0.067	0.061	-0.178 **	-0.248 ***	0.171	0.205 *	-0.021	-0.002
to Minority Schoolmates	(0.077)	(0.079)	(0.062)	(0.064)	(0.093)	(0.094)	(0.098)	(0.099)
Minority-White Difference in Exposure	0.769 ***	0.786 ***	0.795 ***	0.763 ***	0.602 ***	0.592 ***	0.703 ***	0.705 ***
to Poor Schoolmates	(0.096)	(0.097)	(0.080)	(0.081)	(0.102)	(0.102)	(0.101)	(0.102)
Minority-White Difference in Exposure		-0.075		0.729 **		-0.440 *		-0.365
to Novice Teachers		(0.242)		(0.235)		(0.183)		(0.219)
Minority-White Difference in Exposure		0.101		0.518 ***		-0.013		-0.093
to Chronically Absent Teachers		(0.155)		(0.147)		(0.123)		(0.169)
White-Minority Difference in Schools'		0.057		0.063		0.042		0.151
Offerings of Gifted Programs		(0.084)		(0.078)		(0.085)		(0.090)
Minority-White Difference in Schools'		0.003 **		0.000		-0.004 *		-0.002
Student/Teacher Ratios		(0.001)		(0.002)		(0.002)		(0.002)
Coefficients on Growth of Gap								
Minority-White Difference in Exposure	0.000	-0.005	-0.005	-0.012	0.012	0.003	0.012	0.011
to Minority Schoolmates	(0.013)	(0.014)	(0.011)	(0.011)	(0.017)	(0.017)	(0.017)	(0.017)
Minority-White Difference in Exposure	0.042 *	0.036 *	0.036 *	0.029 *	0.006	0.005	0.008	0.002
to Poor Schoolmates	(0.017)	(0.017)	(0.014)	(0.014)	(0.018)	(0.018)	(0.017)	(0.017)
Minority-White Difference in Exposure		0.063		0.085 *		0.114 ***		0.079 *
to Novice Teachers		(0.046)		(0.041)		(0.035)		(0.037)
Minority-White Difference in Exposure		0.045		0.057 *		0.034		0.103 ***
to Chronically Absent Teachers		(0.030)		(0.026)		(0.024)		(0.029)
White-Minority Difference in Schools'		0.003		-0.003		0.001		-0.035 *
Offerings of Gifted Programs		(0.016)		(0.014)		(0.015)		(0.015)
Minority-White Difference in Schools'		-0.001		-0.001 *		0.000		0.000
Student/Teacher Ratios		(0.000)		(0.000)		(0.000)		(0.000)
N (Units)	7,850		2,330		9,600		3,170	

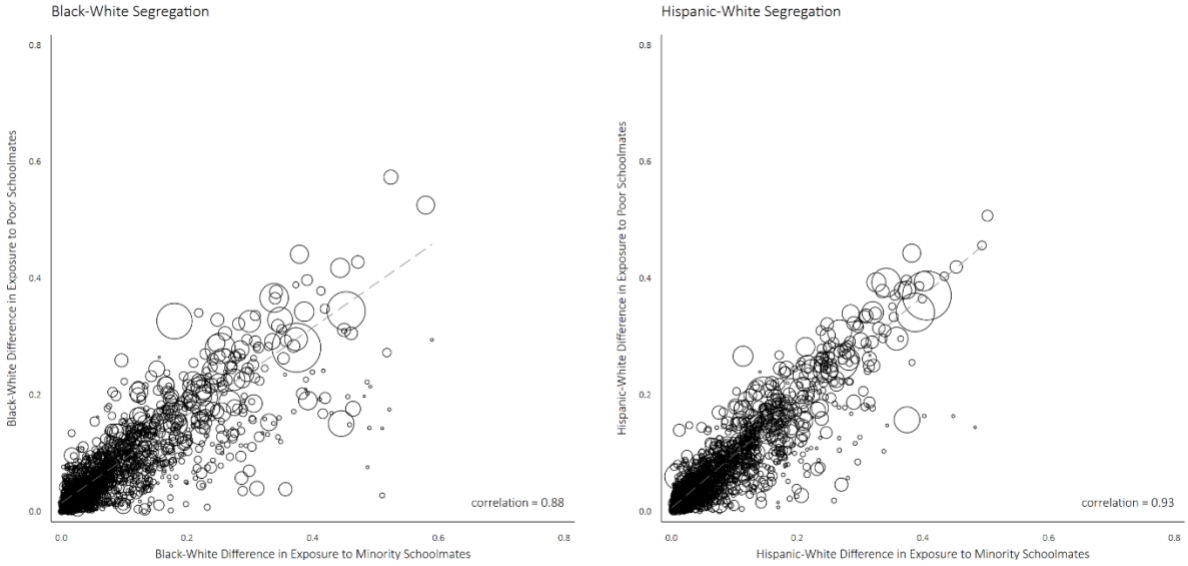
* p<.05; ** p<.01; *** p<.001.

NOTE: Analytic Sample is the sample used in the paper; Reduced Sample includes districts in the analytic sample that enroll at least 100 White and 100 Black (Hispanic, in White-Hispanic models) students in grades 3-8 combined, on average. All models also include measures of grade (centered on grade 3), cohort (centered on 2008) and math (centered on .5). Control variables include black-white or Hispanic-white difference in exposure to minority neighbors and poor neighbors, overall and white-black or white-Hispanic difference in SES variables (proportion BA+, logged median income, proportion in professional occupations,

poverty rates, proportion of single mother headed households, SNAP receipt rates, unemployment rates, and home ownership rates), proportion black, and proportion Hispanic. Sample sizes are rounded to the nearest 10, per IES disclosure requirements.
SOURCE: U.S. Department of Education, National Center for Education Statistics, ED*Facts* Assessment Data, “State Achievement by Performance Levels,” years 2009-2019, authors’ calculations; U.S. Department of Commerce, Bureau of the Census, American Community Survey (ACS), authors’ calculations; U.S. Department of Education, Office of Civil Rights, Civil Rights Data Collection (CRDC), survey years 2009-10, 2011-12, 2013-14, 2015-16, 2017-18, authors’ calculations; U.S. Department of Education, National Center for Education Statistics, The NCES Common Core of Data (CCD), "Public Elementary/Secondary School Universe Survey," survey years 2008-09 through 2018-19, authors’ calculations.

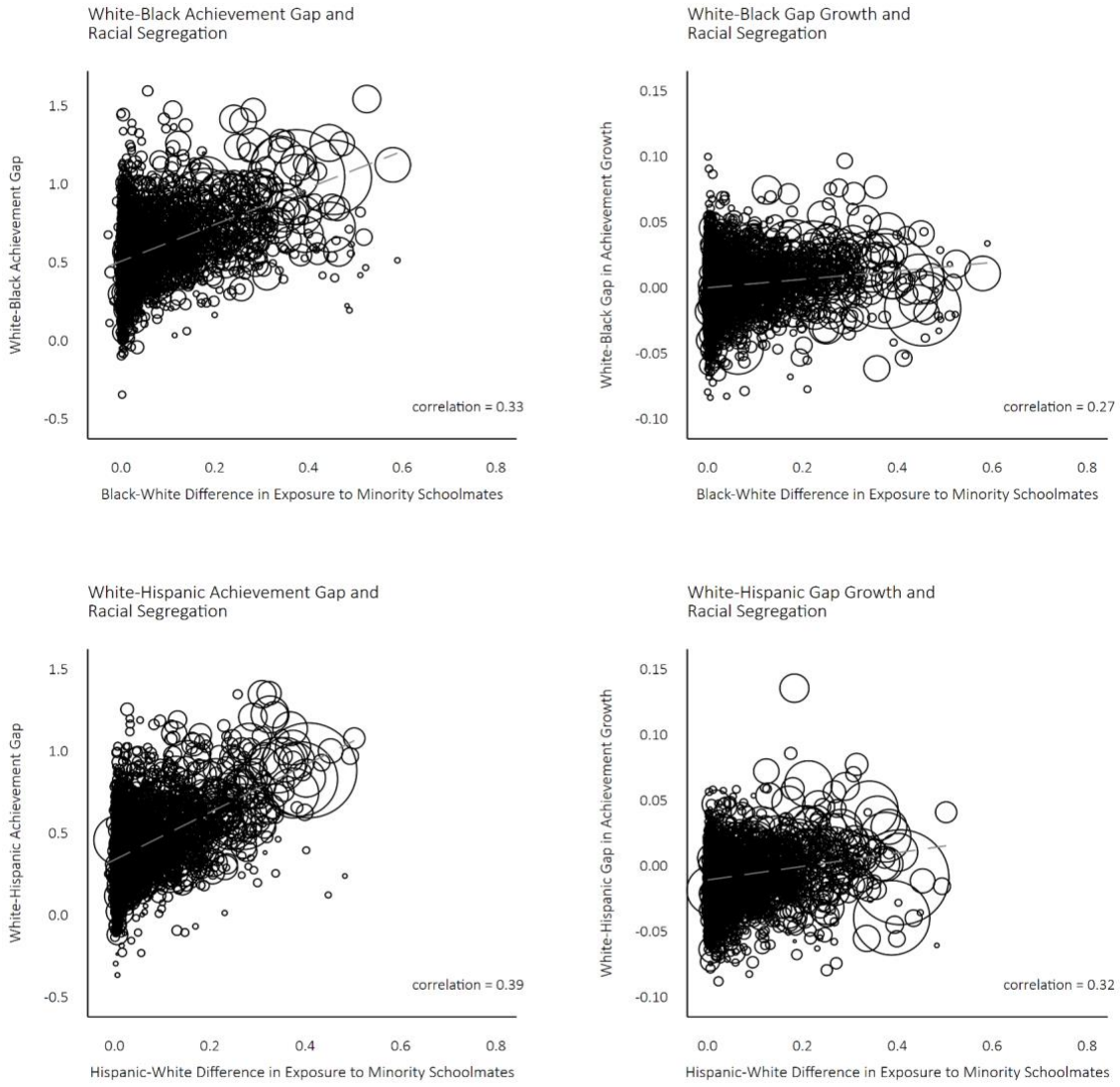
FIGURES

Figure 1. Association between Racial Segregation and Differences in Exposure to Poor Schoolmates



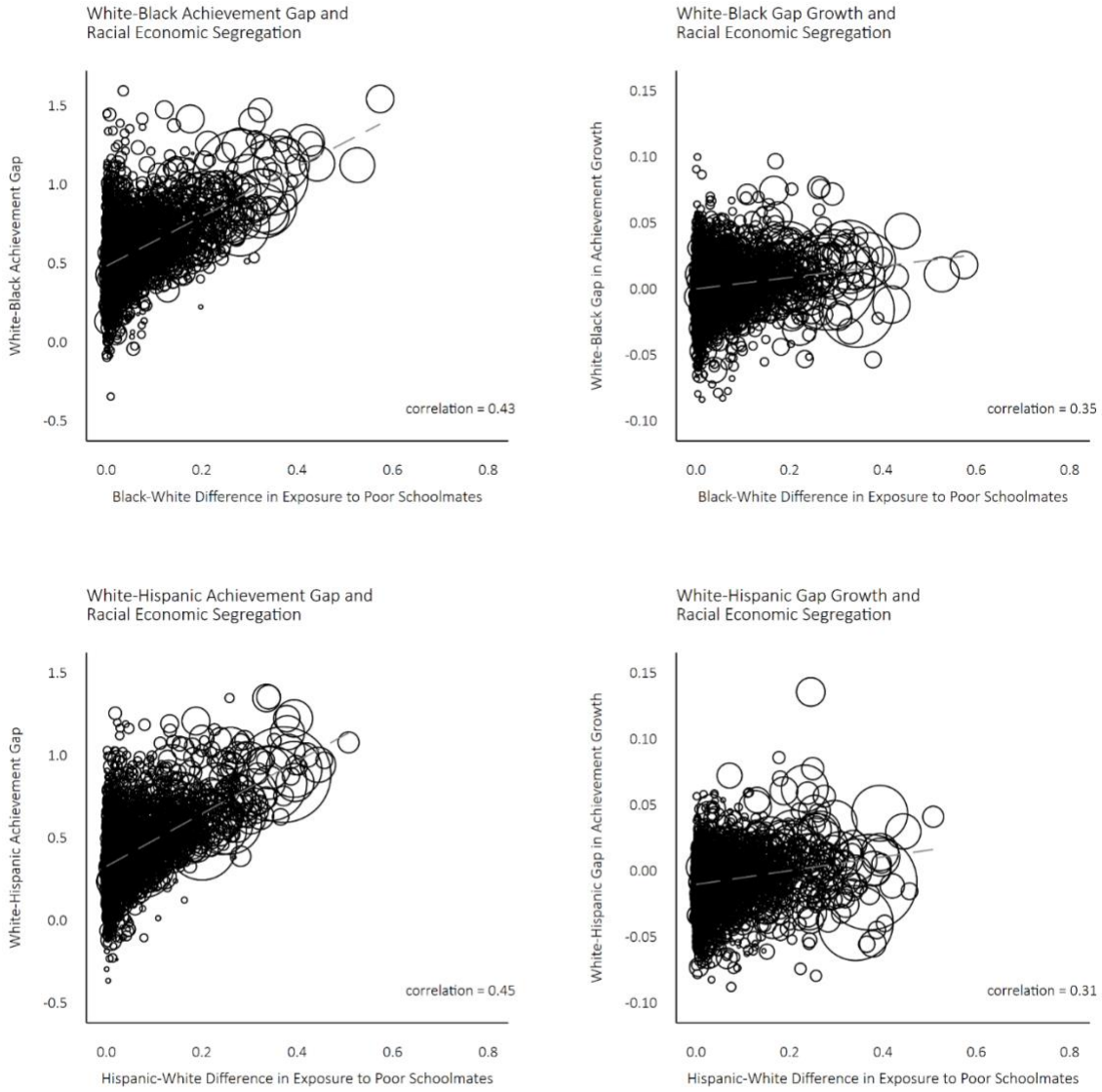
SOURCE: U.S. Department of Education, National Center for Education Statistics, The NCES Common Core of Data (CCD), "Public Elementary/Secondary School Universe Survey," survey years 2008-09 through 2018-19, authors' calculations.

Figure 2. Association between Differences in Exposure to Minority Schoolmates and Achievement Gaps and Gap Growth Rates



NOTE: White-Black and White-Hispanic achievement gaps displayed on the y-axis are measured at grade three. SOURCE: U.S. Department of Education, National Center for Education Statistics, The NCES Common Core of Data (CCD), "Public Elementary/Secondary School Universe Survey," survey years 2008-09 through 2018-19, authors' calculations. U.S. Department of Education, National Center for Education Statistics, ED*Facts* Assessment Data, "State Achievement by Performance Levels," years 2009-2019, authors' calculations.

Figure 3. Association between Differences in Exposure to Poor Schoolmates and Achievement Gaps and Gap Growth Rates



NOTE: White-Black and White-Hispanic achievement gaps displayed on the y-axis are measured at grade three. SOURCE: U.S. Department of Education, National Center for Education Statistics, The NCES Common Core of Data (CCD), "Public Elementary/Secondary School Universe Survey," survey years 2008-09 through 2018-19, authors' calculations. U.S. Department of Education, National Center for Education Statistics, ED*Facts* Assessment Data, "State Achievement by Performance Levels," years 2009-2019, authors' calculations.

APPENDIX TABLES

Table A1. Means, Standard Deviations and Sample Sizes Used in Cross-Sectional Models, Counties and Metropolitan Areas

	Counties				Metropolitan Areas			
	White-Black		White-Hispanic		White-Black		White-Hispanic	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
White-Minority Gap, Mean Achievement	0.513	0.216	0.355	0.208	0.683	0.202	0.496	0.202
White-Minority Gap, Achievement Growth Across Grades	0.003	0.020	-0.009	0.018	0.014	0.018	-0.001	0.016
Minority-White Gap in Exposure to Poor Schoolmates	0.063	0.096	0.052	0.085	0.180	0.116	0.154	0.111
Minority-White Gap in Exposure to Minority (Black+Hispanic) Schoolmates	0.088	0.124	0.071	0.099	0.235	0.164	0.189	0.129
Minority-White Differences in Exposure to Poor Neighbors	0.035	0.043	0.022	0.030	0.082	0.047	0.055	0.035
Minority-White Differences in Exposure to Minority Neighbors	0.083	0.099	0.053	0.062	0.188	0.132	0.123	0.077
Proportion Black	0.132	0.200	0.118	0.189	0.146	0.142	0.146	0.142
Proportion Hispanic	0.124	0.166	0.129	0.173	0.189	0.197	0.189	0.197
Proportion BA+ (ACS)	0.206	0.092	0.205	0.089	0.269	0.081	0.269	0.081
White-Minority Difference in Proportion BA+ (ACS)	0.094	0.068	0.111	0.075	0.122	0.068	0.144	0.085
Proportion BA+ (2000 Census)	0.164	0.082	0.164	0.080	0.198	0.078	0.198	0.078
White-Minority Difference in Proportion BA+ (2000 Census)	0.051	0.124	0.082	0.141	0.066	0.085	0.103	0.085
Median income (Ln $) (ACS)	10.734	0.244	10.733	0.237	10.844	0.176	10.844	0.176
White-Minority Difference in Median income (Ln $) (ACS)	0.487	0.156	0.281	0.110	0.518	0.168	0.339	0.122
Median income (Ln $) (2000 Census)	10.652	0.255	10.650	0.247	10.765	0.221	10.765	0.221
White-Minority Difference in Median income (Ln $) (2000 Census)	0.423	0.365	0.353	0.447	0.413	0.239	0.365	0.243
Professional Occupation Rate (ACS)	0.315	0.060	0.315	0.059	0.351	0.058	0.351	0.058
White-Minority Difference in Professional Occupation Rate (ACS)	0.119	0.058	0.167	0.065	0.130	0.047	0.182	0.070
Home Ownership Rate (ACS)	0.719	0.073	0.721	0.072	0.666	0.058	0.666	0.058
White-Minority Difference in Home Ownership Rate (ACS)	0.259	0.104	0.223	0.093	0.328	0.083	0.245	0.081
Poverty Rate (ACS)	0.158	0.057	0.156	0.057	0.149	0.040	0.149	0.040
White-Minority Difference in Poverty Rate (ACS)	-0.164	0.053	-0.131	0.045	-0.173	0.059	-0.140	0.047
Poverty Rate (2000 Census)	0.167	0.091	0.165	0.089	0.143	0.070	0.143	0.070
White-Minority Difference in Poverty Rate (2000 Census)	-0.140	0.146	-0.129	0.191	-0.133	0.091	-0.122	0.091
Single Mother Rate (ACS)	0.171	0.056	0.167	0.056	0.185	0.038	0.185	0.038
White-Minority Difference in Single Mother Rate (ACS)	-0.273	0.058	-0.081	0.034	-0.276	0.079	-0.095	0.050
Single Mother Rate (2000 Census)	0.193	0.083	0.187	0.081	0.190	0.054	0.190	0.054
White-Minority Difference in Single Mother Rate (2000 Census)	-0.209	0.159	-0.038	0.166	-0.194	0.108	-0.031	0.084
SNAP Receipt Rate (ACS)	0.127	0.055	0.124	0.055	0.116	0.039	0.116	0.039
White-Minority Difference in SNAP Receipt Rate (ACS)	-0.173	0.052	-0.096	0.041	-0.184	0.062	-0.109	0.061
Unemployment Rate (ACS)	0.073	0.024	0.071	0.025	0.074	0.018	0.074	0.018
White-Minority Difference in Unemployment Rate (ACS)	-0.063	0.024	-0.019	0.015	-0.068	0.025	-0.026	0.017
Unemployment Rate (2000 Census)	0.041	0.025	0.040	0.025	0.040	0.022	0.040	0.022
White-Minority Difference in Unemployment Rate (2000 Census)	-0.049	0.087	-0.033	0.104	-0.043	0.044	-0.035	0.051
N, Units	2,620		2,860		400		400	
N, Observations	511,060		594,030		89,510		90,130	

NOTE: Sample sizes are rounded to the nearest 10, per IES disclosure requirements. Summary statistics are calculated using one observation per unit (district, county, metropolitan area).

SOURCE: U.S. Department of Education, National Center for Education Statistics, ED*Facts* Assessment Data, "State Achievement by Performance Levels," years 2009-2019, authors' calculations; U.S. Department of Commerce, Bureau of the Census, American Community Survey (ACS), survey years 2005-09 through 2015-19, authors' calculations; U.S. Department of Education, National Center for Education Statistics, The NCES Common Core of Data (CCD), "Public Elementary/Secondary School Universe Survey," survey years 2008-09 through 2018-19, authors' calculations.

Table A2. Means, Standard Deviations and Sample Sizes Used in Panel Models, Counties and Metropolitan Areas

	Counties						Metropolitan Areas					
	White-Black			White-Hispanic			White-Black			White-Hispanic		
	Mean	Overall SD	Within Unit SD	Mean	Overall SD	Within Unit SD	Mean	Overall SD	Within Unit SD	Mean	Overall SD	Within Unit SD
Change in Achievement Gap Relative to Prior Year	0.003	0.027	0.023	-0.011	0.016	0.006	0.011	0.043	0.040	-0.005	0.028	0.024
Black-White Gap in Exposure to Poor Schoolmates	0.071	0.108	0.041	0.052	0.091	0.036	0.179	0.122	0.039	0.144	0.114	0.036
Black-White Gap in Exposure to Minority (Black+Hispanic) Schoolmates	0.103	0.136	0.036	0.072	0.103	0.034	0.243	0.168	0.031	0.181	0.131	0.030
Proportion Black	0.167	0.208	0.014	0.117	0.174	0.012	0.166	0.150	0.010	0.159	0.146	0.010
Proportion Hispanic	0.116	0.152	0.017	0.137	0.175	0.020	0.172	0.188	0.017	0.177	0.191	0.017
Proportion Economically Disadvantaged	0.567	0.173	0.047	0.551	0.163	0.047	0.525	0.127	0.037	0.524	0.128	0.037
Average Grade Size	33.3	13.1	3.1	30.8	13.8	2.9	38.8	9.5	1.9	38.7	9.5	1.9
N, Units		2,440			2,820			400			400	
N, Observations		96,980			114,100			17,890			18,110	

* p<.05; ** p<.01; *** p<.001

NOTE: Sample sizes are rounded to the nearest 10, per IES disclosure requirements. Summary statistics are calculated using all observations for all units (district, county, metropolitan area); The data used for the panel models include one observation for each unit-grade-year-subject. The models are based on an unbalanced panel; Mean and SDs of the change in achievement gap are estimated using HLM with precision weights to deal with measurement error.

SOURCE: U.S. Department of Education, National Center for Education Statistics, ED*Facts* Assessment Data, "State Achievement by Performance Levels," years 2009-2019, authors' calculations; U.S. Department of Education, National Center for Education Statistics, The NCES Common Core of Data (CCD), "Public Elementary/Secondary School Universe Survey," survey years 2008-09 through 2018-19, authors' calculations.

Table A3. Achievement Gaps and Differences in Exposure to Minority and Poor Schoolmates, Counties and Metropolitan Areas

	White-Black Gap Models								White-Hispanic Gap Models							
	Cross-Sectional Models				Panel Models				Cross-Sectional Models				Panel Models			
	C1	C2	C3	C4	P1	P2	P3	P4	C1	C2	C3	C4	P1	P2	P3	P4
Counties																
Coefficients on Grade 3 Gap																
Minority-White Difference in Exposure to	1.051 ***	0.445 ***		0.112					1.071 ***	0.433 ***		0.113				
Minority Schoolmates	(0.030)	(0.044)		(0.063)					(0.035)	(0.049)		(0.072)				
Minority-White Difference in Exposure to			0.668 ***	0.569 ***							0.615 ***	0.518 ***				
Poor Schoolmates			(0.054)	(0.077)							(0.057)	(0.084)				
Coefficients on Growth of Gap																
Minority-White Difference in Exposure to	0.048 ***	0.021 **		0.005	0.260 ***	0.251 ***		-0.014	0.055 ***	0.001		-0.018	0.193 ***	0.191 ***		-0.019
Minority Schoolmates	(0.004)	(0.008)		(0.011)	(0.026)	(0.026)		(0.034)	(0.005)	(0.009)		(0.013)	(0.025)	(0.025)		(0.032)
Minority-White Difference in Exposure to			0.033 ***	0.029 *			0.416 ***	0.424 ***			0.014	0.029			0.328 ***	0.339 ***
Poor Schoolmates			(0.010)	(0.014)			(0.026)	(0.034)			(0.010)	(0.015)			(0.025)	(0.031)
N (Counties)	2,620				2,440				2,860				2,820			
Metropolitan Areas																
Coefficients on Grade 3 Gap																
Minority-White Difference in Exposure to	0.737 ***	0.345 ***		0.066					1.005 ***	0.743 ***		0.423 **				
Minority Schoolmates	(0.051)	(0.095)		(0.118)					(0.062)	(0.102)		(0.145)				
Minority-White Difference in Exposure to			0.563 ***	0.518 ***							0.765 ***	0.448 **				
Poor Schoolmates			(0.106)	(0.134)							(0.108)	(0.153)				
Coefficients on Growth of Gap																
Minority-White Difference in Exposure to	0.010	0.033 *		0.024	0.287 ***	0.262 ***		-0.015	0.036 ***	0.008		0.036	0.217 ***	0.215 ***		-0.007
Minority Schoolmates	(0.006)	(0.017)		(0.021)	(0.054)	(0.054)		(0.072)	(0.007)	(0.017)		(0.024)	(0.048)	(0.048)		(0.065)
Minority-White Difference in Exposure to			0.034	0.017			0.393 ***	0.402 ***			-0.013	-0.040			0.317 ***	0.322 ***
Poor Schoolmates			(0.019)	(0.024)			(0.051)	(0.068)			(0.018)	(0.025)			(0.047)	(0.064)
N (Metropolitan Areas)	400				400				400				400			
Controls Included?		X	X	X		X	X	X		X	X	X		X	X	X

* p<.05; ** p<.01; *** p<.001

NOTE: All models also include measures of grade (centered on grade 3), cohort (centered on 2008) and math (centered on .5). Control variables in cross-sectional models include overall standardized SES composite, Black-White or Hispanic-White difference in exposure to minority neighbors, White-Black or White-Hispanic difference in SES, proportion Black, and proportion Hispanic. All panel models include the 1- and 2-year lags of the gaps; control variables in panel models P2-P4 include proportion black, proportion Hispanic, proportion economically disadvantaged, and average school size. Sample sizes are rounded to the nearest 10, per IES disclosure requirements.

SOURCE: U.S. Department of Education, National Center for Education Statistics, ED*Facts* Assessment Data, "State Achievement by Performance Levels," years 2009-2019, authors' calculations; U.S. Department of Commerce, Bureau of the Census, American Community Survey (ACS), survey years 2005-09 through 2015-19, authors' calculations; U.S. Department of Education, National Center for Education Statistics, The NCES Common Core of Data (CCD), "Public Elementary/Secondary School Universe Survey," survey years 2008-09 through 2018-19, authors' calculations.